With BRITISH INDUSTRIES FAIR SUPPLEMENT.

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PUBLIC NOTICES

Northampton Polytechnic Institute,

ST. JOHN-STREET, E.C. 1.

A COURSE OF FOUR LECTURES on

DIELECTRICS:

A REVIEW OF RECENT RESEARCH ON PROBLEMS OF INSULATION.

By L. HARTSHORN, Esq., D.Sc., A.R.C.S., D.I.C. (National Physical Laboratory).

On WEDNESDAYS, at 8 p.m., Commencing March 4th, 1931.

The lectures will deal with the phenomena of leakage, absorption, power losses in alternating fields, dielectric strength, &c., and will be particularly addressed to those concerned with the manufacture and industrial applications of insulating materials.

FEE FOR THE COURSE, 5s.

S. C. LAWS, M.A., M.Sc., Principal.

6507

University of London.

A COURSE of FOUR LECTURES on "HARDNESS AND HARDENING" will be given by Dr. W. ROSENHAIN, F.R.S. (Superintendent of the Metallurgy Department in the National Physical Laboratory), at the IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES, Prince Consort-road, S.W. 7, on MARCH 2nd, 9th, 16th, and 23rd, at 5.30 p.m. At the first Lecture the chair will be taken by Professor Sir Henry C. H. Carpenter, Ph.D., M.A., F.R.S., Professor of Metallurgy in the University. Lantern illustrations. ADMISSION FREE, WITHOUT TICKET.

S. J. WORSLEY, Academic Registrar.

6539

Benares Hindu University (INDIA).

ENGINEERING COLLEGE.

WANTED, UNIVERSITY PROFESSOR of MECHANICAL ENGINEERING. Salary Rs. 1200 to Rs. 1500 per month, rising by annual increments of Rs. 50. Starting salary according to qualification.

The Professor appointed will be required to teach Mechanical Engineering subjects, including design, up to the standard of the Honours Degree in Engineering of first-class Universities and Technical Colleges in the West. He should have about fifteen years' experience in the teaching of engineering subjects. Knowledge of Indian vernacular languages is unnecessary.

Candidates selected by the University Council may be interviewed by the undersigned at Benares in April or in England some time in May or June. Single first-class boat fare to Bombay and single first-class railway fare from Bombay to Benares will be given to the professor appointed.

The gentleman appointed will be required to join on or about August 1st and to execute a five years' agreement in the first instance.

The University grounds cover an area of two square miles and the situation is healthy. The sports of the University are well organised and the social life is quiet, but pleasant. Hill stations, such as Darjeeling, Mussoorie, Naini Tal, Simla, can be easily reached from Benares.

Applications, with copies of recent testimonials, a medical certificate and a photograph, with the names of two gentlemen for reference, should be forwarded to the Principal so as to reach him at Benares not later than April 5th, 1931.

CHARLES A. KING, Principal, Engineering College, Benares Hindu University (India).

Benares, January, 1931. P800

University of Birmingham.

FACULTY OF SCIENCE.

PROFESSORSHIP OF MECHANICAL ENGINEERING.

The Council of the University invites APPLICATIONS for the CHAIR of MECHANICAL ENGINEERING, vacant by the retirement of Professor F. W. Burstall.

The stipend offered is £1200 a year.

Twenty-four copies of applications, which may be accompanied by copies of not less than three testimonials, references, or other credentials, should be forwarded to the Registrar, The University, Edgbaston, Birmingham, to reach him not later than 9th March, 1931.

It is desirable that the selected candidate should enter upon his duties on the 1st of October next.

Further particulars may be obtained from

C. G. BURTON, Secretary.

6490

City and Royal Burgh of DUNDEE.

ELECTRICITY DEPARTMENT.

The Corporation invites TENDERS for the SUPPLY and ERECTION of COAL and ASH-HANDLING PLANT at the Generating Station, Carolina Port, Dundee.

Specification, schedule of quantities, form of Tender and general conditions of contract and drawings may be obtained from the undersigned on payment of a deposit of £2 2s., which sum will be returned upon receipt of a bona fide Tender.

Tenders (sealed in envelopes provided) must be lodged with W. H. Blyth Martin, Esq., Town Clerk, City Chambers, Dundee, not later than on Wednesday, 11th March, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

D. H. BISHOP, B.Sc., M.I.E.E., General Manager and Engineer.

Electricity Supply Department, Dudhope Crescent-road, Dundee, 13th February, 1931. 6541

Corporation of Durban (Natal).

The Corporation of Durban (Natal) is prepared to receive TENDERS for the SUPPLY and DELIVERY, free on board, British port, of OVERHEAD LINE EQUIPMENT, comprising :—

1500 Galvanised Cross Arms and Back Straps.

1000 Porcelain Insulators suitable for 3000 volts.

Specifications and drawings may be seen at the offices of Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W. 1.

Sealed and endorsed Tenders (in duplicate) must be delivered to the undersigned on or before Monday, 2nd March, 1931.

The lowest or any Tender will not necessarily be accepted.

By Order, WEBSTER, STEEL and CO., 9, St. Helen's-place, London, E.C. 3, Agents to the Durban Corporation.

6557

The Engineer

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PUBLIC NOTICES

Rugby Urban District.

WATERWORKS.
PUMPING MACHINERY.
CONTRACT No. 3.

The Council of the Urban District of Rugby invite TENDERS for the PROVISION of CERTAIN PUMPING MACHINERY at their Avon Works. The plant will comprise Two Installations of Small Unit Electrically Driven Centrifugal Pumps.

The specification with general conditions and form of Tender may be inspected, and a copy of the specification and form of Tender may be obtained (on payment of Three Guineas, returnable if a bona fide Tender be made), on application at the office of the Water Engineer of the Council, Benn-buildings, Rugby, and at the offices of Messrs. T. and C. Hawksley, Civil Engineers, 34, Old Queen-street, Westminster, S.W. 1, on and after the 21st February, 1931. Copies of the drawing may be obtained from T. and C. Hawksley.

Tenders, endorsed "Tender for Pumps, &c.," must be addressed to "The Clerk of the Council," and delivered in a sealed envelope at the Office of the Clerk of the Council, Benn-buildings, Rugby, at or before 10 o'clock in the forenoon of Monday, the 16th March, 1931.

The Council do not pledge themselves to accept the lowest or other Tender.

D. E. BIART, Clerk of the Council.

Benn-buildings, Rugby, February, 1931. 6564

County Council of Middlesex.

APPLICATIONS are INVITED for a TEMPORARY ASSISTANT, with prospect of permanency, for a DRAUGHTSMAN capable of designing and detailing Steel Bridges. Preference will be given to one with works drawing-office experience.

Salary six guineas per week.

Applications, stating qualifications and experience, should be sent to the undersigned not later than Wednesday, the 4th March, 1931.

A. DRYLAND, C.B.E., M. Inst. C.E., County Engineer and Surveyor.

Middlesex Guildhall, Westminster, S.W. 1, 14th February, 1931. 6546

PUBLIC NOTICES

Knowle Mental Hospital,

FAREHAM, HANTS.

TENDERS are INVITED from British Manufacturers for the SUPPLY and ERECTION of :—

(A) ELECTRICALLY DRIVEN DEEP WELL and SURFACE PUMPS.
(B) OIL ENGINE-DRIVEN DEEP WELL and SURFACE PUMPS.
(C) LIME SODA WATER SOFTENER.
(D) ELEVATED WATER TANK, CAST IRON MAINS and CONNECTIONS.
(E) ELECTRIC BOOSTER, SWITCHBOARD, CABLES and WATER LEVEL INDICATORS.
(F) OIL SEPARATOR, GREASE ELIMINATOR, and WATER CIRCULATOR.

Specifications and drawings, together with forms of Tender, may be inspected at the office of the undersigned, from whom copies may be obtained upon payment of £2 2s. for each of Section "A," "B," "C," "D," "E," and £1 1s. for Section "F," which will be returned upon receipt of a bona fide Tender.

Tenders, endorsed "Waterworks Plant," must be sent to me by March 14th, 1931.

J. RAILTON WYATT, Clerk to the Visiting Sub-Committee.

Knowle Mental Hospital, Fareham, Hants. 6573

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

RAILWAY TICKETS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Railway Tickets," with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 6th March, 1931.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

A. MUIRHEAD, Managing Director.

91, Petty France, Westminster, S.W. 1, 18th February, 1931. 6572

PUBLIC NOTICES

The County of London Electric SUPPLY CO., LTD.

BARKING POWER STATION EXTENSIONS, 1930.
TENDER FOR THE SUPPLY OF BOILER-HOUSE COAL-HANDLING PLANT.

The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of BOILER-HOUSE COAL-HANDLING PLANT in connection with extensions to the Power Station at Barking.

Specifications may be obtained by manufacturers of Coal-handling Plant from the offices of the Company by application on or after Wednesday, 4th March, 1931, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Boiler-house Coal-handling plant," must be delivered, addressed to the CHAIRMAN and MANAGING DIRECTOR, the County of London Electric Supply Co., Ltd., County House, 46/47, New Broad-street, London, E.C. 2, not later than Noon on Wednesday, 1st April, 1931.

The Company do not bind themselves to accept the lowest or any Tender. 6555

16th February, 1931.

The County of London Electric SUPPLY CO., LTD.

BARKING POWER STATION EXTENSIONS, 1930.
TENDER FOR CONDENSER TUBES.

The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of CONDENSER TUBES in connection with extensions to the Power Station at Barking.

Specifications may be obtained by Manufacturers of Condenser Tubes from the offices of the Company by application on or after Wednesday, 25th February, 1931, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Condenser Tubes," must be delivered, addressed to the CHAIRMAN and MANAGING DIRECTOR, The County of London Electric Supply Company, Ltd., County House, 46/47, New Broad-street, London, E.C. 2, not later than Noon on Wednesday, March 18th, 1931.

The Company do not bind themselves to accept the lowest or any Tender. 6554

16th February, 1931.

For Sale.

DRAGLINE EXCAVATOR MACHINES.

Owing to the approaching completion of the Lloyd Barrage Canals, various types and sizes of Steam and Diesel-driven DRAGLINE EXCAVATORS, with spares and subsidiary plant, are available now or in the near future FOR SALE. The machines are all in good working condition, and each type may be personally inspected at work.

Full details of types, specifications, working outputs, working rates, fuel consumption, &c., sale price and other information available to bona fide inquirers on application to—

THE EXECUTIVE ENGINEER, Draglines Division, Barrage Township, Sukkur, Sind, India.

C. S. C. HARRISON, Chief Engineer, Lloyd Barrage and Canals Construction.

Karachi, Dated 27th January, 1931. 6404

Eastbourne Water Works COMPANY.

PUMPING SUPERINTENDENT.

APPLICATIONS are INVITED for the APPOINTMENT of PUMPING SUPERINTENDENT at the Friston Pumping Station, near Eastbourne.

Applicants must be competent to take charge of the Pumping Plant, consisting of Four 240 B.H.P. Paxman Heavy Fuel Oil Engines and Deep Well Pumps, with various Auxiliary Plant, and have had practical workshop experience, as the person appointed will be required to carry out all running repairs.

The salary is £350 per annum, with free occupation of a house adjoining the Pumping Station.

Applications, which must be made on a form obtainable from the undersigned, must reach me not later than the 7th March, 1931.

A. WILKINS, General Manager.

28, Sea Side-road, Eastbourne, 9th February, 1931. 6508

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SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by Firm of Engineers' Merchants, a REPRESENTATIVE for the sale of good specialities. First-class salary, expenses and commission and good prospects to suitable applicant who would be willing to invest up to £2000 in fully secured debentures in business.—Address, P819, The Engineer Office. P819 A

WANTED, CIVIL ENGINEERING ASSISTANT (North of England), under Senior in charge. Able to Survey, Level, Prepare Drawings, &c. Age 25-30. State salary required, enclosing copies, 2 or 3 testimonials, by February 28th.—Address, P801, The Engineer Office. P801 A

ENGINEERING ASSISTANT REQUIRED for Design and Superintendence of Construction of Sewers and Roads on Housing Estate in neighbourhood of London. Salary £7 7s. to £8 8s. a week, according to qualifications and experience.—Write, stating age and experience, to Box No. 212, c/o R. Anderson and Co., 14, King William-street, W.C. 2. 6558 A

FIRST-CLASS PLANT and MAINTENANCE ENGINEER REQUIRED for extensive works in North Midlands.

Successful applicant will be required to Supervise Economical Running and Maintenance, Electric Welding Plant, Power Presses of all descriptions, Machine Tools, &c.

Address fully, stating experience, details of any cost reductions effected, age, salary required, and enclosing recent photograph, 6561, The Engineer Office. 6561 A

FULLY Qualified British ENGINEER REQUIRED for Oil Palm Factory in Malaya and Estate Light Railway. Will be required to supervise economical running and maintenance. Practical works experience and of steam boilers, engines and plant, including hydraulic presses, essential. Knowledge of chemistry a recommendation. Four years' contract. Usual leave on completion. Salary equivalent to £490 per annum with annual increases. Free bungalow and first-class passage out and home.—Address, fully stating experience, age, and where educated, 6570, The Engineer Office. 6570 A

PRODUCTION ENGINEER REQUIRED for Manufacture of Steel Windows. Only first-class men will be considered, who have had extensive experience in actual introduction of highly efficient production and planning methods.

Knowledge of the trade an advantage, but not essential.

Address, stating age, salary required, fullest details of experience and enclosing recent photograph, 6562, The Engineer Office. 6562 A

PROGRESS CLERK REQUIRED. Previous Experience essential.—Apply, giving age and full particulars, to BOULTON and PAUL, Ltd., Norwich. 6574 A

REPRESENTATIVES REQUIRED on Commission basis in Cumberland and Westmorland, Derby and Notts., Sussex, Surrey and Kent, Cambridge and Suffolk, South Wales, Bristol, Southampton, Dundee and Aberdeen, Irish Free State, for the Sale of Keenok Patent Reduction Gears. Engineering knowledge essential

State full particulars of experience and area covered. KEENOK GEARS LIMITED, Oaklands-road, London, N.W. 2. 6553 A

REQUIRED, for Large Works in Sheffield, an ENGINEER, who has specialised in Lubrication problems.—State age, experience and salary, Box No. 16, Osborne-Peacock Co., Ltd., 11, Piccadilly, Manchester. 6545 A

WANTED, Good DRAUGHTSMAN, with Experience of Surveying, able to Prepare Route Plans of Street Works.—Address, giving age, experience, salary required, with copies of testimonials, 6563, The Engineer Office. 6563 A

DETAILING DRAUGHTSMAN REQUIRED for Constructional Steel Works in North London. Must be able to prepare shop drawings with minimum supervision and be familiar with Steel Frame (1909) Act) Buildings.—Address, stating age, experience, and salary required, P765, The Engineer Office. P765 A

DRAUGHTSMAN REQUIRED, with Knowledge and experience of the design and construction of Rotary Air Compressors.—Address, stating age, experience, and salary required, 6566, The Engineer Office. 6565 A

DRAUGHTSMEN WANTED by an Electrical Firm, familiar with Control Gear or Switchgear.—Address, stating age, experience, and salary required, 6477, The Engineer Office. 6477 A

TECHNICAL DRAUGHTSMAN REQUIRED, with knowledge and experience of the Calculations and Constructions for all classes of Ropes. Preference given to one with some practical experience.—Address, giving full details of age, experience, and salary required, 6487, The Engineer Office. 6487 A

WANTED, for British Railway in Argentina, UNDER FOREMAN MOULDER for Foundry, with output of 400 tons of Iron Castings and 80 tons of Non-ferrous Castings per month. Free steamship passage provided.

Applicants must give full particulars of experience, salary expected, age, if married or single, &c., and copies (only) of testimonials.

Age must not exceed 30 years.

Write to Box "FOUNDRY," c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. P802 A

SHOP FOREMAN, Experienced Controlling Production fine measuring instruments; must have definite organising ability.—Address, stating age, experience, with copies references, 6560, The Engineer Office 6560 A

SITUATIONS WANTED

ACCOUNTANT, Qualified, SEEKS RESPONSIBLE POSITION with firm of Engineers in the South. Address—
P805, The Engineer Office. P805 B

ADVERTISER, Age 26, Public School and Technical education, DESIRES POSITION with scope; well experienced in cost accounting, progress, planning, ratefixing and organisation.—Address, P815, The Engineer Office. P815 B

A.M.I.E.E. (28), with Initiative and Energy, REQUIRES POSITION, home or abroad. Extensive electrical and mechanical experience, including manufacture, erection, sales, costing and accounts in England and overseas; excellent references.—Address, P804, The Engineer Office. P804 B

A.M. INST. C.E., 38, with Tact and Personality, SEEKS PROGRESSIVE POST, engineering or semi-commercial. Excellent experience, indoor and outside, all forms industrial construction, riverside and dock work.—Address, P808, The Engineer Office. P808 B

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See large advertisement next week.
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SITUATIONS WANTED (continued)

COLLIERY CHIEF MECHANICAL ENGINEER, age 43, DESIRES CHANGE. Excellent references, life experience, including shaft sinking, steam and electric plant erection, compressors, haulage, reservoirs, pumping, sidings, &c. Open to negotiate anything suitable.—Address, 6566, The Engineer Office. 6566 B

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ENGINEER, First-class Technical and Commercial qualifications, fluent French and German, DESIRES CHANGE, home or abroad.—Address, P775, The Engineer Office. P775 B

LOCOMOTIVE ENGINEER, Nine Years with British railway abroad, DESIRES POST. Sound experience D.O., shops and loco. running and maintenance. Executive posts held; fluent Spanish.—Address, P780, The Engineer Office. P780 B

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MECHANICAL ENGINEER (26) SEEKS Progressive or responsible POST; railway workshop, running shed, drawing-office and general engineering inspection experience. Excellent technical knowledge and splendid references.
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W. S. IBBETSON, B.Sc., A.M.I.E.E., M.I. Mar. E. P733 E

LEASE OF IMPOSING OFFICES FOR SALE.
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In consequence of the recent amalgamation of "THE ENGINEER" LTD., proprietors of "The Engineer," with MORGAN BROS. (PUBLISHERS) LTD., proprietors of "The Ironmonger" and "The Chemist & Druggist," the offices of the three journals have now been transferred to new and more commodious freehold premises which have been acquired at 28-31, Essex Street, Strand, W.C. 2.

The remainder of the lease, covering a further twenty-five years, of the offices of "The Engineer" at 33, Norfolk Street, Strand, W.C. 2, is in consequence for sale. This particularly well lighted five-storey building has an area of 8,200 sq. ft., and occupies a site at the corner of Norfolk and Howard Streets, adjacent to the Temple Station, whence Westminster and the City may be reached in a few minutes. The building is of modern construction and has a fine and distinctive elevation. It is in good order throughout, and vacant possession can now be had. Rent £1,600. Moderate price. For further particulars apply to:—

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24, Ryder Street, St. James', S.W. 1.

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In consequence of the recent amalgamation of Messrs. MORGAN BROTHERS (PUBLISHERS) LTD., proprietors of "THE IRONMONGER" and "THE CHEMIST AND DRUGGIST," with THE ENGINEER, LTD., proprietors of "THE ENGINEER," the offices of the three journals have been moved to new and more commodious freehold premises which have been acquired at 28-31, Essex-street, Strand, W.C. 2.

The lease of the entire premises, of which the four well-lighted upper floors have been in occupation of Morgan Brothers (Publishers) Ltd., the Ground Floor and Basement being sub-let to the Aerated Bread Co., Ltd., is in consequence for sale.

Alternatively, the four upper floors (which have also an entrance to Garlick Hill), having a total area of about 7,000 sq. ft. would be let.

The premises are in good order and vacant possession can now be had. Rent £2,000 per annum, inclusive of rates.

For further particulars apply to:

Messrs. FAREBROTHER, ELLIS & CO., 29, Fleet Street, E.C. 4, or to
HENRY BUTCHER & CO., 63 & 64, Chancery Lane, London, W.C. 2.

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A.M.I.E.E. Exam. May 100%, November Exam. 100%
Average 100%.

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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, 29-31, Oxford Street, London, W. 1.
P741 I

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PATENTS

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The Maudslay Centenary.

THE memorial service, announced in our columns last week, to commemorate the centenary of the death of Henry Maudslay, took place on Sunday morning at Woolwich Parish Church, the service being conducted by the Rector, the Rev. Canon A. M. Pickering, who threw out the admirable suggestion that a Maudslay scholarship or prize should be founded. The special lessons were read by Mr. A. F. Hogg, Principal of the Woolwich Polytechnic, and a spirited allocution on Maudslay's work and character was spoken by Mr. F. Carnegie, Chief Superintendent of Ordnance Factories, Royal Arsenal. The Mayoress and Borough Councillors of Woolwich and several descendants of Maudslay were present. After the service the congregation walked in procession to the Monument in the churchyard, where the Mayoress, after a few appropriate words, deposited a chaplet on behalf of the Newcomen Society for the Study of the History of Engineering and Technology. Another chaplet was placed on the tomb by the Maudslay family, and a third by the Freemasons' Lodge to which William, the father of Henry, belonged.

The Institution of Electrical Engineers.

ON Thursday, February 12th, the annual dinner of the Institution of Electrical Engineers was held at the Connaught Rooms, London, the President, Mr. Clifford C. Paterson, being in the chair. In proposing the toast of "The Institution," Mr. Herbert Morrison, the Minister of Transport, pointed out that although the Institution was the youngest engineering body in the country, it had the largest number of members—a fact that was symptomatic of the growth of the electrical industry. In a series of conferences with electricity supply undertakings in various parts of the country, he had urged the supply industry to go forward to the utmost possible extent in the improvement of its services, and although the conferences were primarily undertaken with the object of reducing unemployment, he felt that the developments which he advocated would be fully justified by the future demands. It appeared, however, that his efforts had not met with universal approbation, for he had recently been the subject of criticism by the chairmen of two great gas companies, who suggested that the action he had taken on behalf of the Government indicated unfriendly and even sinister intentions towards the gas industry. It was, of course, his duty to urge upon all the industries for which he had to answer in Parliament that they should be efficient and progressive, but in all his speeches he had been careful to point out that he had no desire to check the progress of the great gas industry, which he had always been ready to admit was one of the most progressive in the country. He had, in fact, referred to the enterprising spirit with which the gas undertakings had attacked their problems, and had always made it perfectly clear that there was room for both industries. Objection had also been raised to the fact that he had stated that he lived in an "all-electric" house. He fully expected that if he went for a ride in a motor car, the general managers of the railway companies would accuse him of having struck a deadly blow at transport by rail. The President, in reply, said that electrical engineers were convinced of the benefits that were within the reach of this country as the result of a greater availability of electricity. The Institution honoured the engineer who achieved great works, but cherished even more the men who had sought to unravel the mysteries which underlay almost everything with which the engineer worked. Colonel Sir Thomas F. Purves proposed the toast of "The Guests," to which Sir Roger Gregory, President of the Law Society, and Monsieur H. De le Paulle, President of the Belgian Society of Electricians, responded.

Auxiliary Turbo-Generator Plant for the New Cunarder.

AN order has been placed with the British Thomson-Houston Company, Ltd., of Rugby, for the seven turbo-generators which will be required for the auxiliary services of the new Cunarder now under construction at the Clydebank yard of John Brown and Co., Ltd. Each of the sets, four of which will be used in connection with the main machinery and three for hotel service, will have a designed normal output of 1300 kW at 225 volts, with an overload capacity of 25 per cent. for two hours and of 50 per cent. for five minutes. The combined capacity of the plant, 9100 kW, is, it will be seen, equal to that needed by a town of moderate size. Each set will consist of a ten-stage B.T.H. turbine driving a D.C. generator through single reduction gearing, the turbine running at 5000 r.p.m. and the generator at 600 r.p.m. The sets are of the self-contained type, with an integral turbine and condenser, the whole unit being on one floor level. The main machinery sets, which will supply power to motor-driven engine-room and deck machinery, will work at a stop valve gauge pressure of 370 lb. per square inch and 680 deg. Fah. total temperature. As the hotel service sets, which will supply the heating, lighting, cooking and other domestic requirements, may often be required in port when the main boilers are shut down, they are to be designed to operate with auxiliary boiler steam at a stop valve gauge pressure of 230 lb. per square inch and 650 deg. Fah. total temperature. Arrangements are also to be provided for a supply of bled steam from these turbines for feed-heating purposes. The installation is a noteworthy one, both on account of the high steam pressures and temperatures which will be employed and the large size of the generator units.

The Chamber of Shipping.

THE fifty-fourth annual meeting of the Chamber of Shipping of the United Kingdom took place in London on Thursday morning, February 19th, when the annual report was presented, and Mr. F. C. Allen, the newly elected President, gave his address. As Vice-president for the ensuing year, Mr. R. S. Dalgliesh was duly elected. A resolution was passed on the subject of national expenditure, which recalled the resolutions of 1925, 1928, and 1930, and once more commended them to the attention of the Government and all parties in the State. The opinion of the Chamber is that unless means are found to restore a fair balance between national earnings and taxation the trade of the country must suffer irreparable loss, if it does not experience bankruptcy. Having before it the final report of the Royal Commission on Transport, the Chamber passed a resolution welcoming the Commission's recognition of the value of the coasting trade and the importance of adequate port facilities. Should an Advisory Council on Transport be formed, the view of the Chamber is that it should be mainly composed of members representative of the principal forms of transport affected, who would be likely to approach the subject in a spirit of voluntary co-operation. The ratification of the Load Line Convention and the 1929 Convention on Safety of Life at Sea, the Chamber holds, should take place as soon as possible, in the interests of safety of life at sea. Another resolution drew attention to the necessity of preserving the navigational facilities of all estuaries and rivers, and deprecated the construction of works which might obstruct such navigation. The annual report draws attention to the decline in tramp freights in 1930, the high working costs and the large amount of laid-up tonnage in the world. Some interesting shipbuilding and shipping statistics are also given.

Railwaymen's Pay.

THE final sitting of the National Wages Board, which is considering the question of the pay of railwaymen, took place on Tuesday, February 17th. Mr. Marchbank, representing the National Union of Railwaymen, put forward claims for better pay and better conditions for the lower grades of employees. He said that, in the opinion of the union, the minimum basis of remuneration should be £3 per week, and in support of the statement he put forward estimated budgets for typical families to illustrate the difficulties with which lower grade members had to contend. He also mentioned the case of crossing-keepers, and said that their work had been much extended since the advent of increased road traffic. They were required to be on duty the whole 24 hours, and were sometimes called upon several times during the night to let motor cars cross. The 48-hour week should apply also to them. A holiday of 12 days a year would help men in low-grades to keep fit and would, therefore, be a good investment for the companies. He also wanted the hybrid grades of porter-signalmen and porter-guard abolished. Mr. Lazenby, replying for the companies, said that a £3 minimum would bring low-grade workers on to a level with those in higher grades. He pointed out that the cost of living had fallen several points since the £2 minimum was fixed, and that now the average increase in the wages of conciliation grades over pre-war was 133, and that that figure would be 160 if the £3 minimum was allowed. The chairman, Sir Harold Morris, K.C., closing the public hearing, said that the board might need a little time for consideration, but that it would come to its decision as quickly as possible.

A Southampton—Isle of Wight Motor Ship.

ON Monday last, February 16th, the newly constructed motor ship "Medina," which has been designed and built by John I. Thornycroft and Co., Ltd., at Woolston, for the Isle of Wight Steam Packet Company's service, made a successful demonstration trip in the Solent. The new ship, which is the first motor vessel to be placed on the passenger ferry service between Southampton and the Isle of Wight, has a length of 148ft., with a 28ft. beam and a measurement of 339 tons. Her winter complement of passengers is 542 persons, which number is, however, increased to 650 persons during the summer. The passengers are accommodated in the forward and midship parts of the vessel, space for motor cars being reserved on the deck aft. Both sides of the ship are totally enclosed, giving a main deck promenade on either side. The upper promenade deck is open, and there is a shelter deck house below the bridge. The propelling machinery consists of a twin-screw arrangement of six-cylinder Gardner heavy-oil engines, with a total designed output of 456 S.H.P. at 320 r.p.m. The engines and auxiliary machinery are equipped with specially designed silencers. A feature of the "Medina" is the installation of three "Flettner" rudders of the hand-operated type, one abaft of each propeller, and the other at the bow of the ship, for use when navigating in very shallow water. We are given to understand that the owners of the ship have been impressed by the ease with which she is handled, and the low operating costs of the oil engine machinery, and it seems not unlikely that the "Medina" will be followed by other motor vessels of a similar type. Most of the steamers in the present service of the company are, it may be recalled, of the paddle type, and have seen many years of service.

The British Electrical and Allied Industries Research Association.

AT the annual luncheon of the British Electrical and Allied Industries Research Association, held at the Savoy Hotel, London, on Friday, February 13th, the President, Sir Frank Heath, paid a tribute to the late Sir Charles Parsons, whom he described as the greatest engineer of his time, a great research worker and a great man. No engineer recognised the value of research more than Sir Charles, and no one was more capable of grappling with the problems associated with the high-pressure steam turbine. In spite of all the important things that were going on, the firm of C. A. Parsons and Co. stood by itself as a leader among the engineering businesses of the world. No industry, he continued, was better equipped to deal with its many scientific and practical problems than the electrical industry. A scheme was under consideration for a new testing station for dielectrics, and he hoped that the Association would be able to make out such a good case for it that even the Chancellor of the Exchequer might help. It was true, in all matters of industrial research, that old knowledge hindered modern understanding, and that flexibility was the essence of success. The report of the Association, which was discussed at the annual meeting before the luncheon, records a large amount of important research work, and shows that increased financial assistance has been forthcoming. A most pleasing feature has been the renewal of support on a liberal scale by the Department of Scientific and Industrial Research, and it is considered that to have obtained increased support from the Government in these difficult times is itself sufficient testimony to the national importance of the Association's work.

Heavy-Oil Engines in the U.S. Navy.

CONSIDERABLE discussion has been caused in America by a clause in the Naval Construction Authorisation Bill, under which the Secretary of the Navy is empowered to spend £100,000 on the purchase of experimental heavy-oil engines in Europe for American war vessels. Reports have been published in America to the effect that in the opinion of certain naval officials, and of some members of the Naval Affairs Committee of the House of Representatives, the American heavy-oil industry has not kept pace with the European industry, and that American builders are not equipped to supply engines that will meet the Navy's requirements. These allegations have been vigorously denied. It is claimed that American heavy-oil engine builders are fully abreast of those in Europe, and that there is a complete system of co-operation between firms on both sides of the Atlantic as regards the interchange of technical knowledge, designs, inventions and staff. In at least one respect, namely, in the matter of castings, American heavy-oil engine practice is claimed to be in advance of European practice. The leading firms in the industry, it is asserted, have operated successfully and profitably for the past twenty years or so in spite of the lack of orders for heavy-oil engines for use in the American Navy and mercantile marine. It is pointed out that whereas experiments made by the U.S. Navy itself to construct heavy-oil engines to foreign designs resulted in failure, the American submarines built during the war were fitted with engines produced in private plants, and that those engines proved satisfactory. Among the leading heavy-oil engine builders in America are the McIntosh and Seymour Corporation—a subsidiary of the American Locomotive Company—the Sun Shipbuilding and Dry Dock Company—licencees for the Doxford opposed-piston engine—the Cooper-Bessemer Corporation, the Winton Engine Corporation, the Nordberg Manufacturing Company—holding the Fiat rights—Busch-Sulzer Brothers—Sulzer engines—the Bethlehem Shipbuilding Corporation, the Newport News Company and three others—Werkspoor engines—the Hoover, Owens, Rentschler Company—M.A.N. engines—the Worthington Pump Corporation, and the New London Ship and Engine Company—M.A.N. engines. As in this country, American manufacturers seem to have relied, to a large extent, on foreign licences.

THE BEAUHARNOIS HYDRO-ELECTRIC POWER SCHEME

(*For description see opposite page.*)

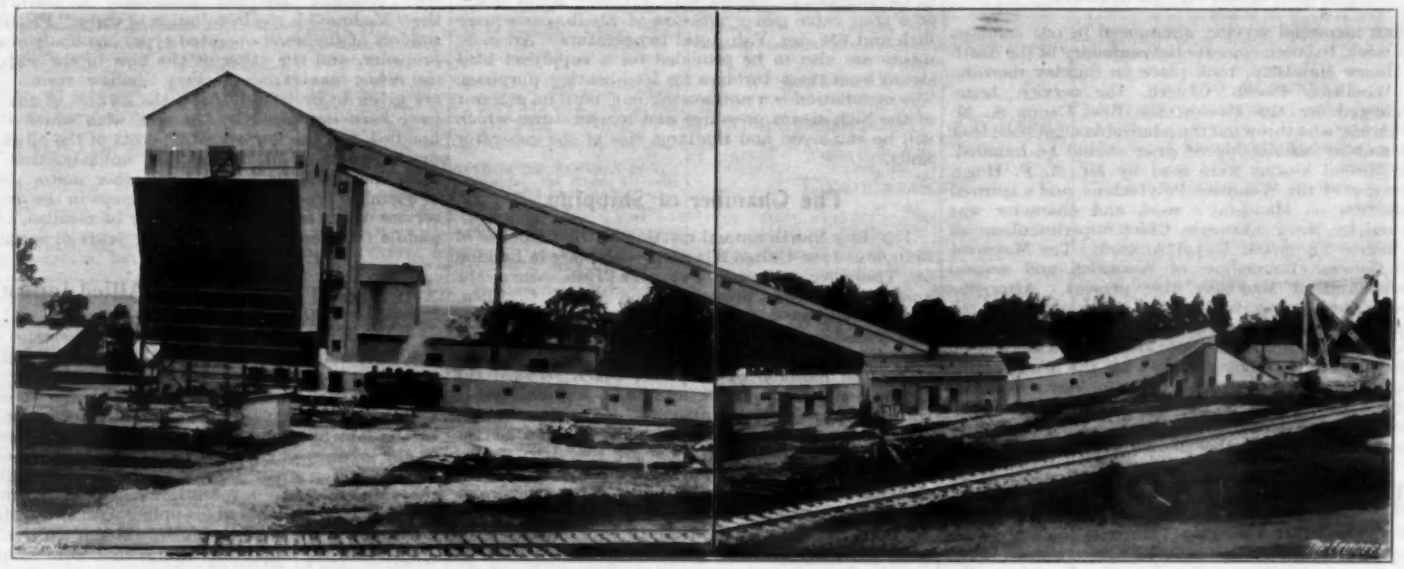


FIG. 6—GENERAL VIEW OF CRUSHING AND MIXING PLANT

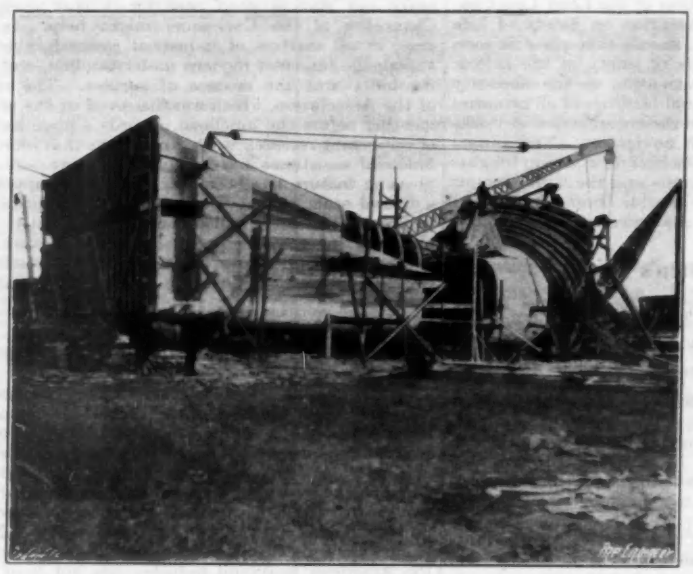


FIG. 7—DRAFT TUBE FORMS FOR MAIN UNIT

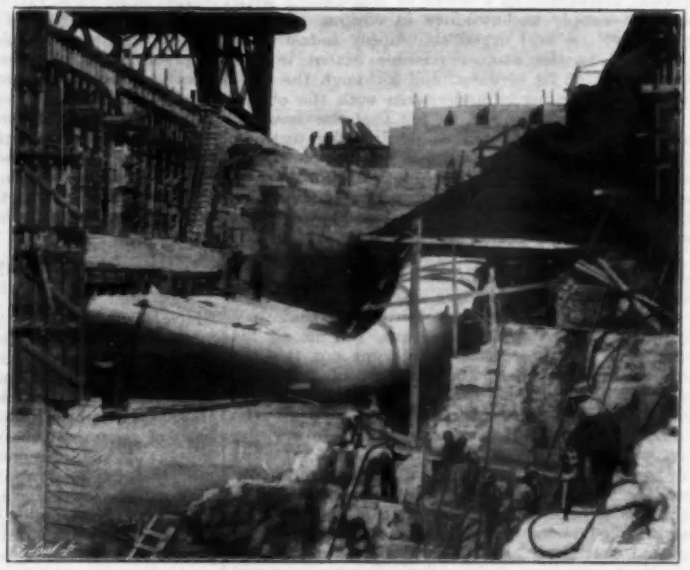


FIG. 8—DRAFT TUBE FORMS FOR TWO AUXILIARY UNITS

FIG. 9—SETTING BASE RINGS FOR AUXILIARY UNITS

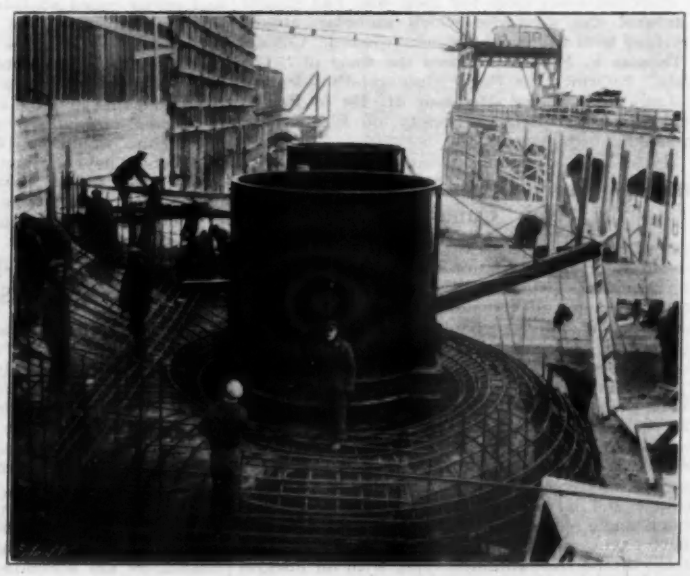


FIG. 10—SCROLL CASE AND PIT LINER READY FOR POURING CONCRETE

The Beauharnois Canal and Hydro-Electric Power Scheme.

No. II. (*Conclusion*).*

THE construction of the dykes is as follows:—There are actually two earth embankment mounds on each side of the canal. That nearer the canal is taken up to a level of 8ft. or so above high water level in the canal. The dykes are formed by surface soil brought to the site by tower excavators or draglines. As the soil was not of any great depth, a wide area had to be traversed to obtain sufficient material. That sometimes necessitated the use of long-span draglines. The inner or canal embankment is over 100ft. wide at the bottom and with a general maximum of 22ft. above the original ground level, though in places, where there is depression in the ground, that height is increased. The canal-ward slope is 1 in 3 and the other slope 1 in 2. At the top the mound is flat and has a width of 15ft. The slope facing the canal is eventually to be pitched with stonework. The outer mound is arranged with its centre line not less, and in some places much more, than 184ft. away from that of the canal mound. It is 70ft. wide at the base and with slopes of 1 in 2 on each face the sides meet at the top in a point at an elevation of 3ft. above the highest water in the canal. Half-way between the two mounds there is a trench, 12in. wide at the bottom, which is taken down to impervious clay, and the space between the two mounds is filled up by the material dredged from the canal by the dredger, from which it is discharged through pipes. A strip of land, more than 2000ft. wide beyond the outer dyke, which is bounded on its side away from the canal by a drainage ditch, is available for the deposition of hydraulically discharged dredged material which is incapable of being contained between the two mounds. The two inner, or canal, mounds or dykes are arranged with their centre lines 3380ft. apart. The ship channel, which will eventually be 600ft. wide and 27ft. deep, is being dredged to that depth from end to end of the canal, but to a less width at the outset than it will finally have. Its sides have slopes of 1 in 5 at the bottom and 1 in 4 at the top. It is being formed close to the north embankment and it has a downward horizontal slope towards the power house of 1 in 23,000ft. In time to come, when the necessity arises, the Federal Government intends to construct locks leading from Lake St. Louis to the canal level. It is said that there will be only two locks in this flight.

The route of the canal is crossed by railway in three places—twice by the New York Central and once by the Canadian National. In view of the fact that in time to come the canal will be used for navigation and that the canal crossings will have to have opening spans for the passage of vessels, the Government insisted that the points of crossings of the lines should be at right angles to the canal. That meant re-locating all three lines, as, originally, all crossed the canal route at an angle. Other diversions included that of the canal feeding the upper waters of the St. Louis River, and that of the river St. Louis itself. These diversions are shown in Fig. 1 *ante*, which has been reproduced from the issue of December 11th last of our contemporary *Engineering News-Record*. To this issue we commend our readers, as it contains further particulars and details than are included in these articles. From the same source, we learn that, except where they cross the navigable channel, the bridges are to be made up of deck-plate girders, 100ft. long, supported on narrow concrete piers. Vertical-lift trusses are proposed for the navigable channel crossings, but, until the channel is put into service for navigation purposes, the railways and the highways, of which there are to be two, will be carried across the channel by shorter spans carried on temporary piers. Concrete piers for the lifting spans are, however, being built as part of the present undertaking.

As has been said, the only rock formation met with in the whole length of the canal is at the power-house end. Indeed, the whole of the power-house site has had to be excavated in solid rock, the material being sand stone, with a high silica content. Much of the excavated material is being used for the making of concrete, both as aggregate and for the formation of sand, all of the latter used on the site being produced from that material crushed and sieved. The excavated rock, as it is removed from the power house and tail race sites, is taken either to the rock crusher or to the rock pile. Later on, rock from that pile will be used for lining the inner banks of the canal. The total rock excavation involved in the foundations for the tail race, which extends for a length of some 500 yards, into deep water in Lake St. Louis, is said to be some 1,500,000 cubic yards. Indeed, it is expected that the excavation will have, in some cases, to be taken down to 120ft. or so below the original level of the ground in which the navigable channel is excavated. A cross section of the power house, which is also reproduced from the article by our contemporary, *Engineering News-Record*, referred to above, is given in Fig. 11. By the summer of this year it is anticipated that the whole of the steel work of the power house will be completed, and that the bricklayers will have begun their work. Two of the four 50,000 H.P. generating units will be wound to generate 25-cycle current for transmission over long distances, while two will be wound to generate 60-cycle current for distribution locally. In addition, there are to be two units each of 8000 horse-power for service purposes. The installation will, at first, therefore, have a total capacity of 216,000 H.P. In the original sanction, an amount of 40,000 cusecs of water was permitted to be taken from Lake St. Francis. The rights of the Valleyfield plant, amounting to 13,000 cusecs, were, as mentioned above, subsequently acquired, so that the Corporation will have at its disposal, at the outset, a total of 53,000 cusecs. That will permit, with a fall of 83ft., of the generation of some 400,000 H.P., so that when the full number of ten 50,000 H.P. units is installed, the station will already be equipped beyond its sanctioned capacity for water utilisation. Already, so we are given to understand, the Corporation has engaged itself to supply a very large bulk of the power which it will be in a position to distribute when all the ten units are in position, all of it, so we gather, within a radius of 15 miles, so that the transmission voltage will not necessarily be very high. The price charged for power in bulk is to be at the rate of 15 dollars—say, £3—per horse-power year. Negotiations now under weigh, coupled with the favourable position of the plant, lead to the belief that an industrial area will spring up about Beauharnois. It is estimated that when the 500,000 H.P. of plant is installed, the Beauharnois power house will have cost some 130 dollars per H.P. That figure, of course, does not include other charges, such as the cost of transmission or distribution.

As will be observed from Fig. 11, the turbines will be of the vertical spindle type. They will be protected from obstacles coming down the canal by means of vertical gratings, and the flow to them from the canal will be controlled by gates. The turbine casings and flumes will be of reinforced concrete. As can be imagined, the concrete mixing plant for this huge undertaking is on an extensive scale. The concrete, which is all made by weight, is mixed in two mixers, each of 2 cubic yards capacity, which are housed in a substantial building. The mixers deliver into 2-cubic yard bottom-discharge buckets, which are taken to the points where the concrete is to be used on trolleys hauled by oil locomotives. For winter work, since the stone and sand are produced continuously as and when required, and are, therefore, warm from the work, it is only proposed to heat the mixing water, which will be done by steam.

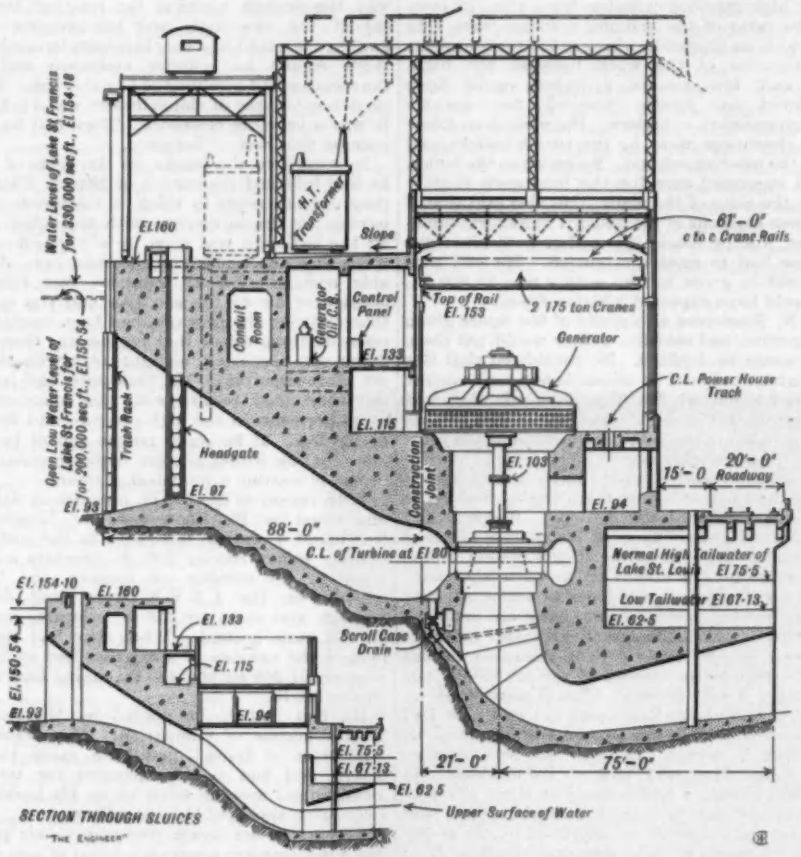


FIG. 11—CROSS SECTION OF THE POWER HOUSE

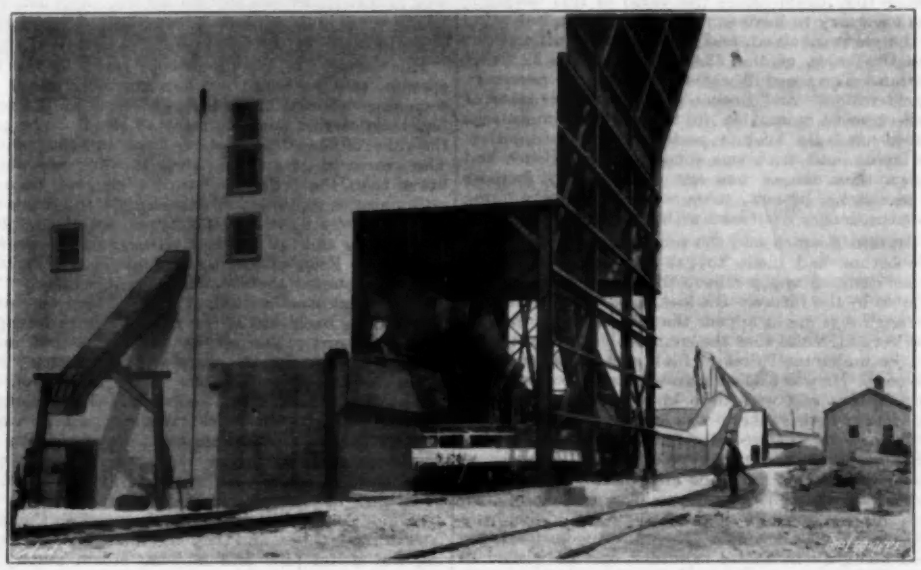


FIG. 12—CONCRETE MIXER DISCHARGING INTO CEMENT TRAIN

The Corporation was careful before it started active operations to obtain the best expert advice possible. The works are being carried out under the direction of a board of three consulting engineers, namely, Mr. Frederick B. Brown, Dr. T. H. Hogg, and Mr. W. S. Lee. The development and execution of the plans are based on reports prepared by and concurred in by those three engineers. Mr. Brown, who is entitled to put M.Sc., M.E.I.C., Mem. Am. Soc.

* No. I. appeared February 13th.

M.E., and Mem. A.I.E.E. after his name, is a prominent consulting engineer of Montreal, with a record of successes in the electric field. Dr. T. H. Hogg, B.A.Sc., M.E.I.C., Mem. A.S.C.E., is the Chief Hydraulic Engineer of the Ontario Hydro-electric Power Commission, who has acted as consultant on many major developments throughout Canada. Mr. W. S. Lee, M.E.I.C., Mem. A.S.C.E., Mem. A.S.M.E., and Fellow A.I.E.E., is the consulting engineer of the Duke Power interests. He has planned all the Duke plants, including the Duke-Price development at Isle Maligne, P.Q. The construction work is being carried out under his direction. Furthermore, independent and favourable engineering reports have been made in the past on the project by a number of prominent engineers, including the late Sir John Kennedy, and Messrs. Johnston, Challies, Surveyer, Papineau, Coutlee, Dansereau, and St. Laurent. The vice-president and general manager of the Corporation, Mr. F. H. Cotheau, is in direct charge of the operations, with, as assistants, Mr. D. F. Noyes, general superintendent; Mr. M. V. Sauer, hydraulic engineer; Mr. B. K. Boulton, electrical engineer; Mr. R. G. Watson, mechanical engineer; Mr. O. B. Bestor, assistant engineer; Mr. J. A. Knight, designing engineer; and Messrs. P. H. Morgan and A. O. Hawes, as assistant superintendents. It is interesting to note that the first fifteen months of actual constructional work proved conclusively that the original estimates of the cost of moving material were on the liberal side. All the equipment employed on the job has been handling material at a rate in excess of, and at a cost below that of, the estimates. As an example of the excess in rate, we may quote the hydraulic dredger, which, as specified, was to have a monthly capacity of not less than 400,000 cubic yards, has actually removed as much as 817,000 cubic yards of stiff marine clay, against a head averaging about 14ft.

In conclusion, we desire to thank the Beauharnois Corporation, one of the assistant superintendents of which is at present in this country, for much of the information contained in the foregoing, and also for the photographs from which the half-tone engravings which have accompanied these articles have been reproduced. On pages 204 and 214 we give some views illustrating the progress of the work.

Institution of Mechanical Engineers

NORTH-WESTERN BRANCH.

The interest which Mr. H. N. Gresley's paper on "High-pressure Locomotives" has aroused amongst railway engineers was demonstrated by the very fine attendance at the Engineers' Club, Manchester, on Thursday, February 5th, when the author read it before the North-Western branch. Mr. H. L. Guy, chairman of the branch presided, and in opening the discussion, gave some figures with regard to the gain derived from increasing the steam pressure. He said the probable gain due to pressure in normal working of the locomotive would be 15 per cent. at 400 lb. per square inch, 20 per cent. at 800 lb. per square inch, and 22 per cent. at 1200 lb. per square inch. Before they could assess the value of this saving it was necessary to have some idea of the capital value of the plant involved, and he asked the author what was the value of the 23,000 locomotives in Great Britain. The fuel bill was only one of the necessary considerations, and probably the attractiveness of high-pressure steam lay in the possible limitations placed on axle loading and length of locomotive. As far as land work was concerned, experience had shown that danger was not increased by increase of pressure. In fact, there was reason for arguing that the danger decreased with the highest pressures.

Captain Beames said the successful attempt which the author had made to get away from large flat boiler surfaces might relieve them of a great deal of trouble in the future. On looking at the diagram of the engine, it might appear that the centre of gravity was very high and that the engine might be unsteady, but he understood that at high speeds that was not the case. He was also concerned about the smoke-box temperature and wished to know what it was. He inquired whether there was any trouble with the refractory walls between the flues and the air chamber outside. In the ordinary type of boiler the superheat was confined in a flue tube and there were frequent blockages by cinders and products of combustion, but, in the author's engine, there would be little trouble on that account. No pumps were used, the feed being by means of injectors, and he wished to know what metal was used for the injector cones. Other information asked for by Captain Beames related to the type of piston packing and the form of regulator and how the engine crew reacted to the higher pressures.

Mr. J. N. Gresham spoke on the capital cost of the high-pressure locomotive and referred to figures recently published in Germany which showed that the maintenance cost increased by about £250 per annum for such engines. A 10 per cent. coal economy would be necessary to justify that increased expenditure. He asked the author if he could give them the air pressure under the ash pan after it had passed through the ducts and round the boiler.

Mr. R. C. Bond said that "No. 10,000" was essentially British in its simplicity of design, and he thought that the cost of maintenance should not exceed that of ordinary locomotives. The engine was of special interest on account of its being a compound. Compound locomotives had not, so far, been a success in this country, and the reason was difficult to analyse. The one exception owed its success entirely to its simplicity. He felt that the time would come when Mr. Gresley would find it desirable to combine the two cut-offs on to one reversing lever. The lining up of the high-pressure cylinders from 12in. to 10in. altered the ratio of the cylinder volumes from 1 to 2·77 to 1 to 4, an alteration which called for comment. The distribution of the work between the high-pressure and low-pressure cylinders could have been altered by merely varying the cut-offs in the high-pressure cylinders. He wished to know what the clearances were in the two cylinders, and what was the receiver volume. Referring to the boiler, Mr. Bond suggested carrying the brickwork slightly higher up the sides of the walls. He also said that if the scale was kept out of the boiler it must form somewhere else, and he asked the author how often the feed heater had to receive attention. He said that the evaporation given by the author was 20,000 lb., and he would have expected a higher figure.

Mr. G. N. Shawcross also spoke of the figure given for evaporation, and said the author would tell them that this would be doubled. He considered that this type of engine would not be utilisable as a tank engine. With regard to cut-off, Mr. Shawcross said they had a main line engine in daily service that was cutting off at 40 per cent. in the high-pressure and 50 per cent. in the low-pressure cylinders.

Mr. S. Jackson said it would have been better if the author had placed before them the figures of the relative coal consumptions of "No. 10,000" and an ordinary "Pacific" type of locomotive engaged in the same service. Referring to the raising of the steam pressure he was not at all sanguine that anything like the theoretical economies would be attained by merely raising the pressure with an ordinary reciprocating type of locomotive. Nor did he think it had been proved necessary or desirable to use water-tube boilers for pressures up to 500 lb. per square inch. The "Horatio Allen" mentioned by Mr. Gresley was about four years old and now had the front and back of the fire-boxes made flat, while the "Winterthur" engine carried 850 lb. pressure and had a flat front and back to its fire-box. He thought Mr. Gresley's boiler was just short of circulating facilities, especially in the fire-box, and said that the circulation would be improved by the provision of downcomers of large diameter reaching from the top drum to the ends of the bottom drums, remote from the fire. On the subject of air preheating, he had had experience of it and decided that the advantage gained did not balance the cost.

Mr. E. F. Lang said that about the time the "Horatio Allen" had been designed, another locomotive had been produced by Baldwins for a pressure of 350 lb. That locomotive had been thoroughly tested by Lawford Fry, and Mr. Lang said he had been surprised in reading the results of the trials to find that they had only obtained an overall efficiency of between 7½ and 8 per cent. That locomotive, which was historic, had established an efficiency not very much more than a modern superheated locomotive of the ordinary type to-day.

Mr. Gresley, in his interesting reply to the discussion, said he could not say anything about the economies effected in his locomotive till all the trials had been carried out. In reply to Mr. Guy, he gave the value of 23,000 locomotives as about £100,000,000. The centre of grvaity of "No. 10,000" was rather lower than the "Pacific" type of engine, because, although the top drum appeared high, the drum was comparatively light and the lower part of the boiler was heavier and full of water. In running a non-stop train from King's Cross to Edinburgh, a "Pacific" engine consumed about 8 tons of coal, whereas "No. 10,000" had used less than 7 tons. There was brickwork at the back and at the side of the forward part of the fire-box. The engine had run 30,000 miles, and the bricks were the same which had been put in when it was built. One row of the brick arch had tumbled down, and it had been found that the engine seemed better afterwards. With regard to superheater tubes and the accumulation of ash, in the lower parts of the boiler there was a steam pipe running right along with openings in it. That had been put in comparatively recently, because the accumulation of dust and ashes occurred on the lower part of those tubes, and they had found that, by opening the steam pipe and blowing steam among the tubes, it disturbed the dust, and if the engine were working hard, the dust was ejected out of the chimney. The nozzles of the injectors were made of stainless steel. The piston packing was the same as was put in when the engine had been built. It was cast iron packing and was used for all the company's superheater engines. The regulator was made of stainless steel. It was a double valve and was of special design. With the 10in. cylinders there had been no difficulty whatever. The pressure was maintained so that it was always between 400 lb. and 450 lb. per square inch. The air pressure in the ash pan was very small and they did not require so much vacuum in the smoke-box. He had no data of the draw-bar horse-power. One train had run on 540 tons from Newcastle to Edinburgh, and had made some minutes in running. He ventured to think that, with properly designed engines, compounding at 200 lb. pressure did not pay. When they got to 450 lb. it was very different. The variation of temperature of the exhaust and the temperature of the inlet steam was so great that it was better to keep the steam in two stages. He had arranged the high-pressure cut-off so that it could be varied. In any future engines he intended to find out what was the correct position for running the relative cut-off for the high and low-pressure cylinders, and then it would be a simple matter to combine them. With regard to cylinder clearance and volume, the receiver had a volume of 6¼ cubic feet. The actual clearance volume of the cylinders was 12·4 per cent. It was a very big clearance. They had no tail rods, because they were a nuisance.

In regard to the bricks up the sides of the walls he had followed the advice of Messrs. Yarrows, and they did not seem to think it mattered very much having the fire in contact with the tubes. Blowing off the sediment was done by a blow-off valve, and was a very simple matter for washing out. A considerable accumulation of sediment was found. The leakage of air to the ash pan and the question of thus reducing the pressure, had been mentioned. An essential thing about that engine was that the inner lining was absolutely airtight, otherwise they would get short-circuiting. Mr. Shawcross had pointed out the very good results with the compound engine at 40 per cent. in the high-pressure and 50 per cent. in the low. If he could reduce cut-off to about 20 per cent. he would get far better results. He was probably wasting a good deal of steam.

With regard to the 500 lb. pressure on flat surfaces, mentioned by Mr. Shawcross, Mr. Gresley said he had found a marked difference in the cost of maintaining boilers having 250 lb. pressure and 180 lb. pressure. A number of engines—the "Pacific" engines—on the L.N.E.R. were built for 180 lb. pressure and some for 220 lb. pressure, and worked on the same ground. When they had come in for repairs the number of stays that had to be renewed were about 200 on the 180 lb. engine and about 500 on the 220 lb.

He had had to be guided by Messrs. Yarrows in the matter of circulation. The boilers on the "Empress of India" had been made to Yarrow's design, and had no downcomers for water. The arrangement was the same as on his boiler, and the circulation appeared to be excellent.

There was not much economy in air preheating, but it did conserve a certain amount of heat and return it to the fire-boxes. It helped combustion, and he did not think it was conducive to the production of smoke. The trailing truck did not make the footplate hard riding. The footplate was the easiest riding footplate of which he knew. The hammer blow of "No. 10,000" when running at five revolutions per second was the equivalent of ·97 of a ton. The water capacity of the boiler was just over 5 tons.

THE SALT INDUSTRY OF CANADA.

THE salt industry of Canada is one of the oldest, non-metallic industries of the country, dating back to the early years of the last century, when the Hudson's Bay Company obtained its local supplies from the brine springs of the Mackenzie basin. The discovery of salt in Ontario in 1886 was, however, the real beginning of the industry on a substantial basis, and production from the Ontario field has been continuous since that time. The opening of the Malagash deposits in Nova Scotia in 1918 inaugurated the first rock salt mine in the country, and has materially assisted in supplying the demands for salt in the Maritimes. With the discovery of rock salt at McMurray, Alberta, and the more recent encountering of thick beds of salt in drill holes just south of Moncton, New Brunswick, the known resources of Canada in this mineral have been considerably extended.

Sodium chloride, or common salt, as it is more familiarly called, finds a use in a large number of industries, and the consumption for domestic use forms a steady demand, depending upon the population. The increasing use of salt in Canada for the manufacture of chemicals has, in recent years, caused a rapid rise in the production of salt, and there is every reason to look forward to a rapid expansion of the industry as the country grows.

To meet the demand for information relating to the Canadian salt industry, the Mines Branch of the Department of Mines, has recently published a report by L. H. Cole, entitled "The Salt Industry of Canada." This new report, which supplements and brings up to date the previous report on the same subject, issued by the Mines Branch over fourteen years ago, comprises 116 pages, and is profusely illustrated with photographs, diagrams and maps. It covers the salt occurrences throughout Canada, takes up the mineralogy and technology of salt manufacture, and briefly describes the allied industries using salt in their processes. A chapter is also devoted to the consumption and marketing of salt and includes general salt statistics.

Copies of this report, No. 716, may be obtained on application to the Director, Mines Branch, Department of Mines, Ottawa.

Obituary.

SIR CHARLES PARSONS, O.M.

IN our last issue we had to report with great regret the death of the Hon. Sir Charles Parsons. Not engineers alone, but men of science throughout the world will mourn the passing of the greatest pioneer of the century, worthy to be ranked with Newcomen, Watt and Trevithick. He died on February 11th, while on a cruise in the West Indies.

Sir Charles, the fourth and youngest son of the third Earl of Rosse, was born on June 13th, 1854. His father trained him almost from birth to be an engineer and a scientist, and as a boy he showed evident indications of a love for invention and experiment. At the age of thirteen the workshop was his constant resort. He produced many interesting devices, and in 1866 he and his brothers constructed a 4 H.P. steam carriage, which is reported to have travelled at 10 m.p.h. He was educated privately in company with his brothers and had the advantage of being taught by a series of distinguished men of science, among whom were Sir Robert Ball and Dr. Johnstone Stoney.

His education was extended when he went up to St. John's College, Cambridge, where after a three years' course he was placed eleventh wrangler. His activities at the University, however, were not confined to the intellectual side. He rowed in his college boat and won his college "pairs."

Coming down from Cambridge at the age of twenty-two, he was apprenticed to Armstrong's at Elswick and began his engineering career in earnest. At the University he had constructed models of an epicycloidal steam engine, and the first motor of this type was built at Elswick while he was still an apprentice. It was so made that the cylinders rotated round a rotating crank shaft at half the speed of the shaft; several more were built at a later date while Sir Charles held an appointment with Kitson and Co., of Leeds.

It was not until Sir Charles became a junior partner in Clarke, Chapman, Parsons and Co., Ltd., of Gateshead, that he made any great efforts to develop his ideas on the use of steam in a turbine. The conception was by no means original to him. Many patents had already been taken out embodying the principle, but owing to lack of fundamental knowledge or the existence of practical difficulties none of them had been successfully worked out. It is doubtful whether Sir Charles ever referred to them, but at any rate it seems that nothing but discouragement could have been the result. He preferred to work along his own lines. Some time before he had undertaken a number of investigations and had come to the conclusion that the fall in pressure of the steam could not be successfully used in a single turbine, but must occur in a series of wheels. He made the assumption that under such conditions the action would approximate to that of a turbine using an incompressible fluid, such as water, and that the aggregate efficiency of the series would be comparable with that of a water turbine. This he found to be a correct assumption, but a bucket speed of about 220ft. per second was necessary. As junior partner and chief of the electrical department he set about investigating the mechanical difficulties involved in constructing a turbine to have this high bucket speed. His efforts were successful, and on April 23rd, 1884, two patents were filed in his name and the history of the modern steam turbine may be said to have begun.

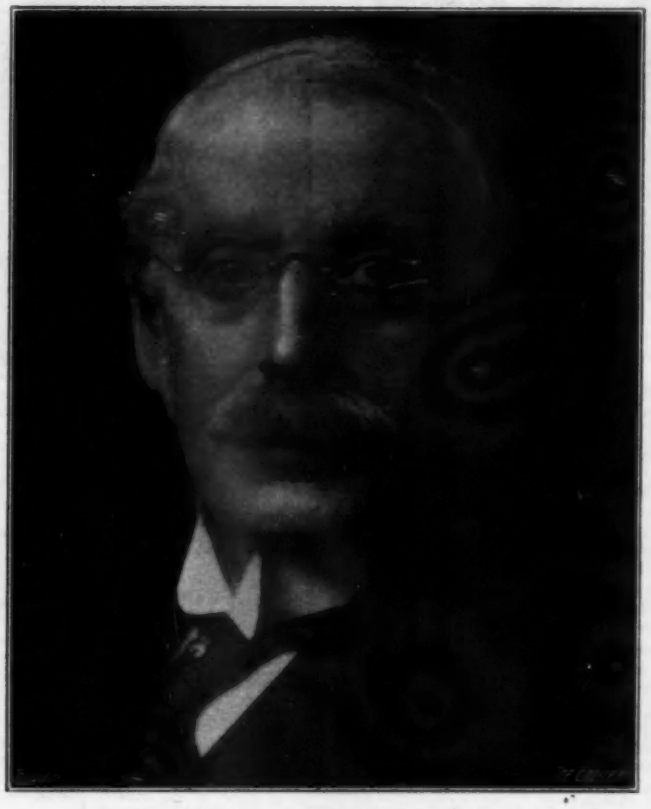
The first patent covered a method for building a dynamo to run at a high speed, and the second a method of constructing a steam motor on the turbine principle which was to be used for driving the dynamo. Considering the small amount of knowledge available at the time with regard to dynamos, the invention of such a machine to run at 18,000 r.p.m., a speed determined by turbine considerations might almost be regarded as an achievement as great as that of producing the turbine. The principle underlying the patent for the steam motor was that the steam should pass through a series of fixed and moving blades, expanding a little as it passed through each row, so that it acquired a velocity to be expended in driving the next one. The unmanageably high velocities which would have occurred if the expansion had all taken place in one set of nozzles were thus avoided. The principle may appear obvious enough now, but to get the true perspective the words of the patent must be read through the eyes of those living at that date. No turbine then existed and the opinion was generally held among engineers that nothing better than the steam engine could be found.

Less than a year after the application for the patents the first turbine and dynamo unit was built. It developed 4 kW, using saturated steam at a pressure of 60 lb. per square inch and exhausting to atmosphere. Its steam consumption was as much as 200 lb. per kilowatt-hour. The rotor was constructed by threading a number of gun-metal rings on a shaft; they were held tightly together and in contact with a central collar by nuts at the ends. The projecting portions of the rings were cut through by slots at 45 deg., the leaves of metal between the slots forming the blades upon which the steam acted. The slots became deeper and wider towards the exhaust end of the turbine to allow for the expansion of the steam. It is interesting to note that even in this, his first turbine, Sir Charles had realised that end thrust must exist and had countered it by making his steam enter midway along the shaft and exhaust at each end. The form of the blades, it will be seen, was almost flat, but this shape was dictated more by the difficulties of manufacture of curved blades than by considerations of efficiency. This historic machine has now found a resting place in the Science Museum in South Kensington. The method of governing the machine throws considerable light upon the mechanical ingenuity of the inventor. A fan was fitted to it in connection with the lubrication of the bearings with the object of creating a partial vacuum. This vacuum varied with the speed, and the alterations were communicated to the throttle valve by means of the deflection of a spring-loaded leather diaphragm. Finer adjustment was provided by mounting a soft iron bar on the top of the dynamo capable of rotating about a vertical axis. The magnetism of the dynamo field caused the bar to have a tendency to lie in line with it, and this tendency was resisted by an adjustable spring. One of the ends of the bar moved across an inlet port to the suction side of the fan, closing it more or less according to the strength of the field, which, of course, varied with the speed. The vacuum in the chamber was thus altered and the position of the throttle valve changed by the action of the diaphragm mechanism.

During the following five years about three hundred turbo-generators of this type were made, the largest having a capacity of 75 kW. It used steam at 100 lb. per square inch and, exhausting to atmosphere, had a consumption of 55 lb. per kilowatt-hour. By 1888 improvements had been made to the blading, which was then curved, and to the drum, which was made in stages of increasing diameter so that a greater area of steam passage could be provided without unduly lengthening the blades.

In 1889, however, the partnership between Sir Charles and Clarke, Chapman and Co., was dissolved, but the latter kept the rights in the turbine patents. Undaunted by the fact that he could no longer develop the parallel flow system, which was covered by the original patents, Sir Charles founded in 1890 the firm of C. A. Parsons and Co., Ltd., and built his famous Heaton Works at Newcastle-on-Tyne. For the next five years, working under difficult conditions and unable to use his original designs, he laboured to produce a radial flow turbine. The first that he constructed was of the inward flow type, but he soon realised the advantages to be gained by using the outward flow principle, and all his later designs were made in that manner. During this period he tested almost every previous turbine invention and many others which have since been claimed to be new. Though the majority of the results were purely negative, he refused to be discouraged, and many of the details of design regarded as so important to-day were developed during this time. Amongst these was the principle of "gust" governing, which was used for many years afterwards in Parsons turbines, but it was only adopted after exhaustive trials of many other types.

It was an outward radial flow turbine of 100 kW capacity made during this period for the Cambridge Electric Light Company in 1891 that became famous by proving more economical in steam consumption than any steam engine built up to that date. It was also the first turbine to work condensing. Running on steam at a pressure of 100 lb. per square inch with a superheat of 50 deg. Fah., it had a consumption of 27 lb. per kilowatt-hour when exhausting to a vacuum of 27in.



SIR CHARLES PARSONS, O.M.

It must have been a great relief to the inventor when, in 1894, the Courts restored to him the rights in his original patents, for already the limitations of the radial flow design were becoming obvious to him. Progress has been rapid since that date. The adaptation of the turbine to large power outputs occurred so quickly that before his death Sir Charles could claim that the great majority of power-houses generated energy by means of machines that he had invented. It was in the development of the turbine for marine propulsion, however, that the greatest interest was aroused throughout the world. Many of the small turbo-generators first made had been installed as auxiliary sets in ships, for which purpose they were well adapted. Thus the turbine principle was already well known among marine engineers. It is said that Sir Charles himself discouraged the use of turbines for ship propulsion, but whether this is true or not it is certain that the experimental investigation of the subject was started as early as 1894 by the formation of a small company known as the Marine Steam Turbine Company, the managing director of which was Sir Charles himself. A number of experiments with models led finally to the design of the famous "Turbinia." Its wonderful performance at the naval review of 1897, when the little ship of only 44 tons displacement proved itself the fastest vessel afloat, brought about a considerable interest among naval engineers, with the result that two destroyers driven by turbines, the "Viper" and the "Cobra," were built. The unfortunate loss of both vessels in 1901 caused a temporary setback, but after the "Velox," another destroyer of a similar type, had proved thoroughly successful, the development in the use of turbines for all kinds of warships was very rapid, while the mercantile marine soon found them essential for certain classes of ships.

In more recent times Sir Charles had interested himself in proving that successful use could be made of high steam pressures and temperatures to obtain more economical results, and the experimental Clyde pleasure steamer "King George V.," with a pressure of 550 lb. per square inch and a temperature of 800 deg. Fah., is likely to be the forerunner of a number of steamships using such pressures.

Although he will always be remembered as the inventor and developer of the steam turbine, Sir Charles Parsons' genius was not by any means confined within the limits of steam engineering. His father, the Earl of Rosse, famous for his work in astronomy and for the giant telescope built on his estate, had seen to it that the education of his sons was widely scientific, and, though during the period when he was engaged in developing the design of the turbine Sir Charles did little other work, he took a very great interest in optics in later years. He took over the Derby Crown Glass Works and interested himself in constructing searchlights and their mirrors and solving other problems in connection with light,

and later he and Sir Howard Grubb formed the company, known under their names, to make astronomical instruments and telescopes. His experiments on the behaviour of various substances, particularly carbon, under the action of high pressures are of great interest, although the results obtained were largely negative. At first he used hydraulic pressure to prevent the carbon from volatilising while it was heated by an electric furnace; but, gaining negative results, he arranged to fire a bullet into a hole bored into a block of steel. The carbon or other substance to be compressed was placed either at the bottom of the hole or in the nose of the bullet. With a nozzle velocity of 5000ft. per second it was estimated that a pressure of 2000 tons per square inch was obtained, but even under this enormous pressure carbon could not be persuaded to crystallise. It was at this period, when he was President of the Engineering Section of the British Association, that he made the suggestion that a shaft should be sunk into the earth to a depth of 12 miles. He believed that such a shaft would prove of great value in determining the nature of the interior of the earth.

Trouble with the "Turbinia" as first designed led him to make a long series of experiments with model propellers. The screws to be tested were rotated by a weight and clockwork wheel train and a delicate spring balance measured the thrust. The screw was mounted on an axis passing through a gland in the side of a tin vessel 12in. in diameter in such a manner that its thrust was tangential to the direction of rotation of the water in the vessel. The screw thus worked with a moderate slip ratio. A plate glass window in the side of the tin provided a means of observing and photographing what took place. Much very valuable work was done with this apparatus, leading to a great improvement in propeller design, but Sir Charles realised that screws could seldom be run at a speed sufficiently high to ensure a good turbine efficiency. He therefore turned his energy to perfecting helical gearing for use between the propeller and the turbine. The success of the "Vespasian," in which geared turbine machinery was installed, led to great developments in the use of this form of drive. Later, in conjunction with Mr. S. S. Cook, he undertook an investigation into the causes of the erosion of high-speed screw propellers, the results of which were dealt with in a paper read before the Institution of Naval Architects in 1919. This paper was followed by another in 1927 on the causes of erosion in the tubes of condensers, the chief of which appeared to be the turbulent motion of the water in the water boxes.

Throughout the latter part of his life the engineering and scientific genius of Sir Charles Parsons was recognised by many societies. He was elected a Fellow of the Royal Society in 1898 and was awarded the Rumford Medal in 1902. In 1911 he was made K.C.B., he received the Order of Merit in 1927, and in 1928 was the first engineer to win the distinction of being awarded the Copley Medal. He was a frequent contributor to the "proceedings" of engineering societies. Becoming a member of the Institution of Civil Engineers in 1892, he served on the Council. He was made an honorary member of the Institution of Mechanical Engineers in 1925, having joined the Institution in 1882, and the Institution of Electrical Engineers, of which he became a member in 1888, made him an honorary member in 1909. All these bodies combined to confer upon him the Kelvin Medal in 1926, and he was awarded the Faraday Medal in 1923. The Iron and Steel Institute presented him with the Bessemer Medal in 1929. He was a Vice-President of the Institution of Naval Architects and President of the North-East Coast Institution of Engineers and Shipbuilders in 1913 and 1914. As a striking tribute to his great scientific knowledge he was elected President of the British Association in 1917, having been President of the Engineering Section in 1904. He also served as President of the Institute of Physics. Liverpool University and the universities of Glasgow and Durham conferred degrees of Doctor of Science upon him. He was married in 1883 to Katharine Bethell, and their only son was killed in action in 1918.

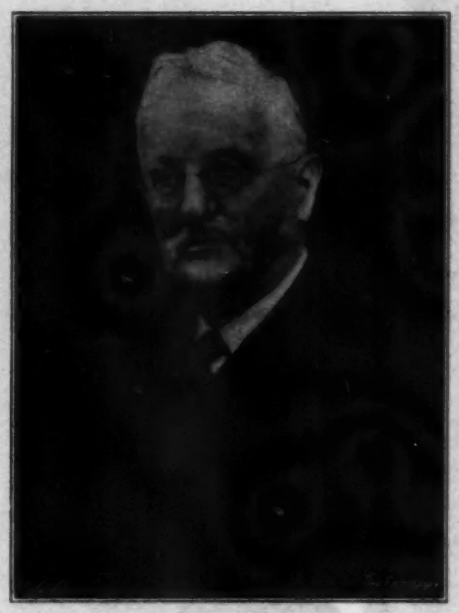
Sir Charles Parsons will be remembered, not only as the inventor of the steam turbine and a great scientist, but also as a generous benefactor to various scientific bodies and for his interest in the welfare of students coming from abroad to the university and schools of London.

All engineers, we are sure, will feel that something should be done to honour the memory of so distinguished a man, and we are glad to be able to report that a memorial service will be held in Westminster Abbey at 2 p.m. on March 3rd.

SIR ARTHUR J. DORMAN.

By the death of Sir Arthur J. Dorman, Bart., K.B.E., the chairman of Dorman, Long and Co., Ltd., which was briefly chronicled in our last issue, Great Britain has lost one of the greatest ironmasters and industrialists of the last half century. Sir Arthur, who was in his eighty-third year, died at his home, Grey Towers, Nunthorpe, Yorkshire, on the morning of Thursday last week, February 12th. He had led an active life, right up to the time of his illness, and, he had expressed the wish to travel to Australia in order to be present, with his co-director Sir Hugh Bell, at the opening of the Sydney Harbour Bridge, one of the many great achievements of his firm.

He was born at Ashford, in Kent, on August 8th, 1848, and was the son of the late Charles Dorman, of Ashford and Maidstone. His education was begun at Christ's Hospital, when the school was still in Newgate-street, and it was continued in Paris. About the age of eighteen, young Dorman was apprenticed to Mr. C. G. Johnson, who was a friend of the family, and one of the principals of Richardson, Johnson and Co., ironmasters, of South Stockton. He remained with the firm for ten years, and in 1866 at the age of twenty-eight, entered into partnership with the late Mr. Albert de Lande Long, and founded the firm of Dorman, Long and Co. The partners acquired the West Marsh and Britannia Ironworks, and they soon began to manufacture rolled joists and other sectional material. From small beginnings, the output of the firm rose in 1899 to over 100,000 tons per annum. The following year it was decided to lay down alongside the steel works, a yard for the building of bridges and the erection and assembling of construction steel work, a new department which rapidly grew and prospered. About ten years later the firm of Bell Brothers, Ltd., became associated with Dorman, Long and Co., Ltd., and plans were subsequently formulated for the large-scale production of open-hearth steel from Cleveland ore. The success of this enterprise led to further extensive developments. In 1903 the company acquired a controlling interest in the North-Eastern Steel Company, Ltd., a firm which specialised in the production of steel rails. At a later date works for the manufacture of corrugated iron sheets and a wire works were purchased, in order to create new outlets for the increasing production of iron and steel. About 1915 Dorman, Long and Co., Ltd., absorbed the colliery and blast-furnace undertaking of the Carlton Iron Company



SIR ARTHUR J. DORMAN

and Sir B. Samuelson and Co.; also the steel works and blast-furnaces of the Aclam Iron Company. In order to supply material for munition purposes, the Redcar Steel Works were built in 1916 by the firm's own constructional department, and by the end of the war, this single plant had turned out no less than 165,000 tons of steel. At a later date new plate rolling mills, with a designed output of 300,000 tons of plates per year, were put to work.

Following the outcome of the policy which had been adopted by Sir Arthur Dorman and Sir Hugh Bell over many years, a fusion of interests between Dorman, Long and Co., Ltd., and Bolckow, Vaughan and Co., Ltd., was arranged in 1929, and has proved most successful. Sir Arthur took a great interest in the work of firms abroad, and under his direction constructional steel works were set up in Australia, South Africa, and the Argentine.

In 1924 Sir Arthur Dorman was present at the laying of the foundation stone of the Sydney Harbour Bridge, and in 1928 he made an extensive tour of South Africa. Following the pioneer work done in constructional engineering, the firm of Dorman, Long and Co., Ltd., began the building of bridges, many of which were shipped abroad in sections for re-erection. The largest bridge contract was that for Sydney Harbour, which we have already referred to, but no less important are the recent Dorman Long bridges which have been built over the river Tyne at Newcastle, across the Nile, and over the Limpopo Bridge in Southern Rhodesia. When the Kent coalfield was developed after the war, Sir Charles Dorman took a great interest in this new project, and the possibility of manufacturing steel in South England, and he was a director of Pearson and Dorman, Ltd., and the Channel Steel Company, Ltd. At Redcar he took a great interest in the town-planning problem, and Dormanstown embodies the most modern ideas of house-building and town-planning in the vicinity of industrial works. In recognition of the services of his firm during the war, Sir Arthur was made K.B.E. in 1918, and he was created a baronet in 1923.

On Monday last, February 16th, a special memorial service took place at Christ's Church, Victoria-street, Westminster, at which many engineering and industrial interests were represented.

SIXTY YEARS AGO.

THE scientific Press of America if we may accept the evidence contained in our issue of February 24th, 1871, was, with a few honourable exceptions, characterised, sixty years or so ago, by a very free indulgence in "puffing." If Mr. Ephraim B. Stiggs had a cherry-stoner to sell, he could, we asserted, have a leader praising his machine to the skies if he liked to pay for it. For a consideration Mr. Joshua P. Riggs' potato peeler could be held up to an admiring public, week after week, as the finest in creation. What the scientific Press left undone the manufacturers themselves, we said, completed by way of circulars. A "genuine Yankee circular" had, we remarked, to be seen before its merits and capabilities could be understood. It would seem that in at least one quarter of American industrial life the art of puffing had been carried too far. The water turbine manufacturers of Massachusetts had been among its most distinguished practitioners, and for a long time had rivalled each other, not only with respect to the production of the best turbine, but as regarded the writing of the best circular. Under the pressure of competition the efficiencies claimed for the Massachusetts turbines had been steadily rising. At one time it had been claimed by the makers that their turbines would convert round about 75 per cent. of the energy of the waterfall into useful work. Gradually, that figure was advanced until it became by common allegation about 98 per cent. Then a new manufacturer appeared on the scene and at a bound carried the figure to 185 per cent. An efficiency of 100 per cent. might have been tolerated by the other turbine builders, but the odd 85 per cent. was too much even for them. A group of manufacturers, water-wheel builders, millwrights and engineers numbering 160 all told, petitioned Congress for a law to regulate the sale of water-wheels. They desired that anyone before he sold a water-wheel in Massachusetts should submit a sample for test by an inspector, who would furnish a certificate of performance, which, on demand, would have to be shown to the purchaser. While waiting for Congress to enact a law that would make the tests compulsory, the petitioners had instituted a voluntary system of tests. The testing work was entrusted to Mr. James Emerson, of Lowell, Massachusetts, and in 1869 the Lowell testing flume, subsequently to become so famous in the history of hydraulic engineering, began work. In the issue named we reprinted a report by Mr. Emerson on the tests which he had conducted on numerous water-wheels during 1869 and 1870. Some of Mr. Emerson's comments were amusing, but, in general, he confined himself to a statement of the power and efficiency claimed for each wheel, and the power and efficiency which his meticulously conducted tests showed it to possess. A few of the wheels survived comparison with the claims made for them by their manufacturers, but, for the most part, the tests showed a sad falling away from the figures given in the circulars. The tests conducted during the first two years led to a considerable revision by the manufacturers of their circulars, and in at least one instance the results were so poor that no more wheels of the particular design concerned were made. The more we pondered upon the action taken by the men of Massachusetts in the matter of water-wheels the more did we see in it, so we wrote, for imitation by British engineers in general. Thirty years and more had, however, to pass until, with the foundation of the National Physical Laboratory, means were provided in this country whereby optional testing by impartial authorities became available to all manufacturers of mechanical and physical devices.

BOOKS OF REFERENCE.

The Blue Book: The Electrical Trades Directory and Handbook, 1931. 25s.—The forty-ninth edition of this well-known handbook follows closely the lines of previous issues, with the sections brought up to date. It opens with general information for the British electrical industry, followed by a manufacturers' "Who's Who," alphabetical, geographical, and classified trades sections. The remainder of the volume is divided into the following sections:—Colonial, Continental, Asiatic and African, Central and South American, and the United States of America. The "Blue Book" can well be recommended as a valuable reference book to all connected with the electrical industry.

The Motor Ship Reference Book for 1931. The Temple Press, Ltd. Price 5s. net.—The seventh annual issue of this reference book is well up to the high standard which has been set by the previous editions. The figures given in the preface are most informative. When the first edition of the book was published, the tonnage of motor ships in service was nearly 2,000,000 gross, whereas it is now about 9,000,000 tons. There are several additions to the new volume, for apart from bringing the existing information up to date, a number of new types of heavy-oil engines are described, and a section containing the new regulations of Lloyd's Register of Shipbuilding affecting motor ships is included. All the motor ships over 2000 gross tons now on order throughout the world are recorded in tables, with particulars, such as dimensions, machinery, builders, &c. Tables showing motor ships constructed each year from 1924 to 1930 are also given. The general aim of the book is to form a complete summary of information for those connected with or interested in motor ship development. The editor of the *Motor Ship* and his staff are to be congratulated upon the success with which this work has been accomplished, and the excellent drawings and photographs with which the year book is illustrated.

The British Industries Fair.

No. II.*

IN our issue of February 13th we included a special Supplement dealing with some of the exhibits at the Birmingham section of the British Industries Fair, which was opened on Monday last, February 16th. To-day we again publish a special Supplement in which further descriptions of the exhibits will be found. In what follows below we continue the description given in last week's issue of various other exhibits which are to be seen at Birmingham.

PETTERS, LTD.

The largest and most interesting engine shown on the stand of Petters, Ltd., of Yeovil, is an "Atomic" oil engine of improved design, which has been specially designed for marine purposes. The engine, as our engraving, Fig. 11, shows, is a four-cylinder unit, with a bore of 10in. and a stroke of 14½in., designed for an output of 160 B.H.P. at 330 r.p.m.

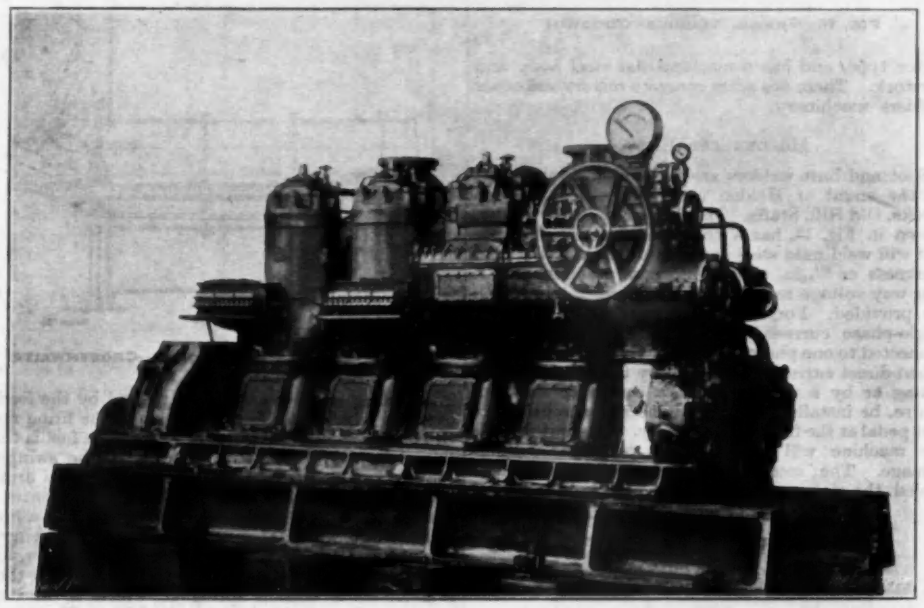


FIG. 11—160 B.H.P. REVERSIBLE "ATOMIC" MARINE OIL ENGINE—PETTERS

As will be seen from our illustrations, Figs. 11 and 12, a very compact arrangement has been secured. The main engine, the fly-wheel casing, with a combined outer bearing and Michell thrust block, along with a circulating water and a bilge pump and an integral air compressor, are all built upon a continuous cast iron bed-plate of rigid construction, and forced lubrication with double pumps is fitted to all bearings. The extreme dimensions of the engine are 14ft. 0½in. length and 5ft. wide and a height of 6ft. 0½in. from centre of shaft. The engine can be immediately started from the cold condition by means of compressed air, while the same medium is employed for direct reversing. When running at full speed the engine can be stopped, started, and then brought up to full speed in the reverse direction within three to four seconds. By the special methods of governing which have been adopted the engine speed under governor control can be varied over a wide range, from the full speed of 330 r.p.m. down to 70 r.p.m. The engine will also idle, we understand, without trouble or attention.

In Fig. 12 we reproduce a longitudinal section through the engine showing the lay shaft with the various drives for the lubricators, the air starting valves, the fuel pump, the tachometer, and the air compressor. On this shaft there will also be seen towards the centre a small fly-wheel which assists in maintaining smooth synchronous running with the main crank shaft. The air compressor drive is taken from an extension crank on the layshaft, and the compressor cylinder is horizontal with the usual inlet and delivery valves. As Fig. 13 indicates the bilge and circulating water pumps are arranged below the compressor to the left and right of the crank shaft respectively, and they are driven by excentrics at one-third engine speed. To the right of the engine one of the two water-cooled silencers will be seen. Returning to the layshaft and its drives, it may be noted that the recording tachometer is of the direct-recording type, with an indicator for ahead and astern running, and a seven-figure record of engine revolutions. The overhead governor is driven by helical gearing, and it operates a spill valve on each fuel pump. The pumps are indicated in Fig. 12. The fuel pump plunger of each pump is actuated by a guided tappet, which is lifted by the roller lever and fuel cam. An arrangement for hand priming is provided, which rotates an independent side shaft and lifts the plunger of the pump. The fuel cams are furnished with two adjusting screws, which permit of very close adjustment. The spill valve mechanism which regulates the exact amount of fuel which is delivered to the cylinders is governor-controlled. On the governor control shaft there is a tappet which rests on a stop on the fuel cam roller lever, and actuates the spill valve plunger. A small clearance is arranged between the plunger and its ball valve, so that the plunger travels a certain part of its stroke before the spill valve comes into action and cuts off the supply of fuel to the atomiser. The cut-off position is varied by the rotary motion of a governor-controlled shaft, which alters the amount of clearance between the plungers and the spill valves.

The air-starting cams are indicated to the left of Fig. 12. They are arranged for ahead and astern working and give an opening which begins at 5 deg. after the top dead centre and ends at 105 deg., which ensures adequate overlapping of the period of opening on all cylinders, so that the engine will start easily in any crank shaft position. Movement of the main hand wheel shown to the right of Fig. 11 controls all starting and manœuvring operations. There is a scroll cam with rocker levers, which is arranged behind the main hand wheel and which transfers the cam rollers to the appropriate ahead and astern position. On the extreme right of Fig. 12 there will be seen a fuel regulating hand wheel, the purpose of which is to control the supply of fuel independently of the governor. When starting from cold, maximum fuel is given by setting this wheel accordingly. The indicating arrow behind the main control wheel is then brought from the "stop" to the "start" position by moving it to the right, which admits air from the storage receivers to the air distributing box and valves. The cam-controlled valves admit air to the cylinders in the correct sequence, until firing commences, which is almost instantaneously, after which the wheel is smartly moved over to the "full speed" position, cutting off the starting air and putting the engine under governor control. Subsequent adjustment of the speed is obtained in intermediate positions between "full speed" and "slow speed" marks, while on moving the wheel over to the "stop" position fuel supply ceases and the engine comes to rest. To reverse the engine, the wheel is brought back from the "running position" into the "stop position," and retained there until

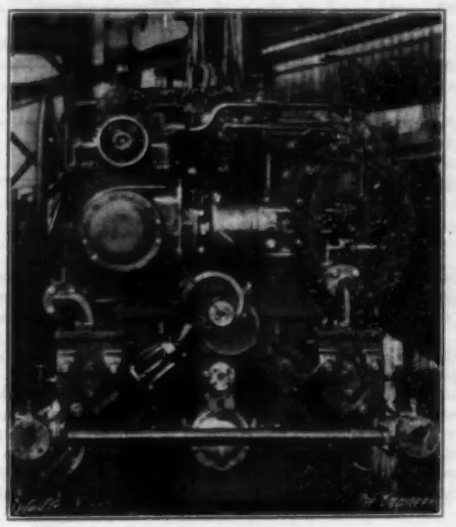


FIG. 13—END VIEW OF ENGINE—PETTERS

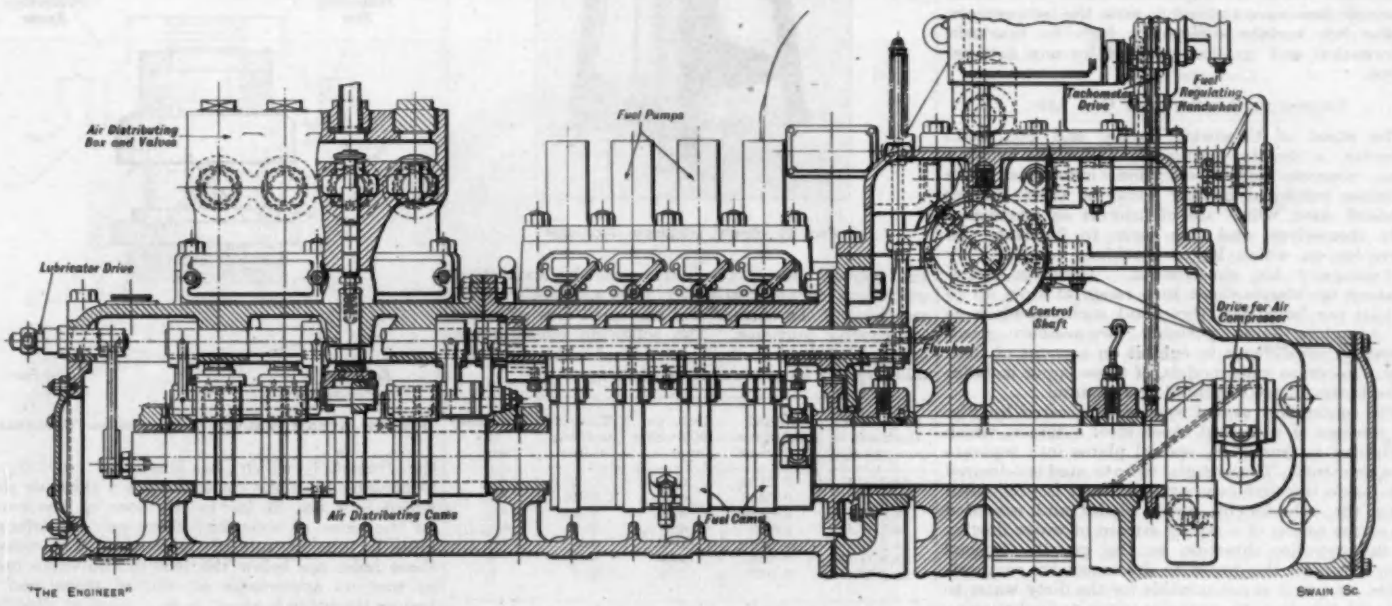


FIG. 12—LONGITUDINAL SECTION SHOWING LAYSHAFT OF 160 B.H.P. ENGINE—PETTERS

* No. I. appeared February 13th.

the crank shaft has come to rest, after which the movement is continued in the same direction until the "start" position is again reached, and the engine is run up to speed in the direction required. As previously mentioned, the time required for complete reversal is only three to four seconds.

Attention may be called to the total enclosure of the fly-wheel, the casing of which serves as a fulcrum when barring the engine round. Two other "Atomic" engines are shown, one a 130 B.H.P., two-cylinder engine, and the other a single-cylinder, 25 B.H.P. motor. In Fig. 14 we reproduce typical fuel con-

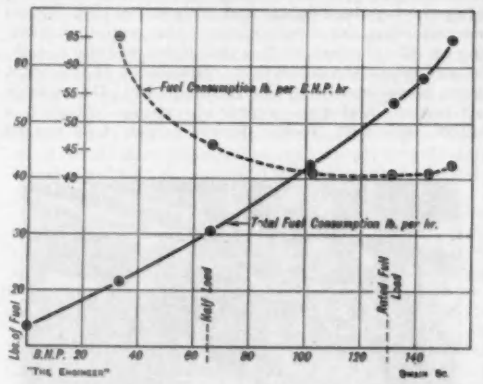


FIG. 14—FUEL CONSUMPTION CURVES—PETTERS

sumption curves for the 130 H.P. engine, and attention may be drawn to the flat nature of the curve between three-quarter load and 10 per cent. overload.

Among the smaller engines, several examples of surface ignition, paraffin and petrol engines are displayed, with powers from 1½ to 8 B.H.P. for tank or hopper cooling. For the starting up of the smaller engines, for which compressed air starting is not employed, the firm has recently developed a new type of electric starting plug, of which we reproduce a section in Fig. 15. The plug body is screwed into the cylinder head in such a position that a portion of the

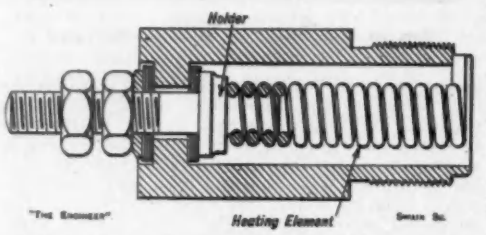


FIG. 15—STARTING PLUG FOR SMALL ENGINES—PETTERS

oil spray issuing from the injector is directed upon the coiled heating element, which consists of a high-resistance non-scaling alloy. The passage of a 6-volt electric current through the element raises its temperature to a cherry red in approximately 1½ minutes and the heat is sufficient to vaporise and ignite the oil charge during the first few revolutions of the engine. After running for half a minute the current is switched off, as the explosions which have taken place will then have sufficed to raise the temperature of the hot surface sufficiently high to maintain vaporisation and ignition unaided by any internal source.

GOODWIN, BARSBY AND CO., LTD.

The stand of Goodwin, Barsby and Co., Ltd., Leicester, is devoted to machinery for the crushed stone, concrete and tarmacadam industries. The machines exhibited include some of their smaller standard sizes, which are of interest as productive units themselves, and also serve to illustrate the principles on which larger machines produced by the company are constructed. Goodwin stone-breakers are standardised in a range of sizes up to 40 tons per hour, but these and such machines as the complete Jacta portable tarmacadam plant, naturally, are difficult to exhibit on account of their bulk. Accurate scale models, of these larger installations, however, are exhibited on the stand.

The contra-flow gravel washer, illustrated by Fig. 16, consists of a riveted sheet steel cylinder, which is divided internally by special plates into separate compartments. The material to be treated is delivered just inside the first compartment, and is progressed along the cylinder by worm blades and cascaded under the action of a strong stream of water flowing in the opposite direction to the gravel. Special scoops transfer the gravel to the successive compartments, and as it is not possible for the dirty water to mix with the clean, the gravel receives its final washing in a compartment containing clean water and emerges from the cylinder under the action of clean water sprays. In the exhibition model, a dredger elevator is fitted to feed the washing cylinder, which is also worthy of notice on account of its very strong construction, having no joints liable to open and prove a source of weakness. This feature may be observed from the illustration, which also clearly shows the screens fitted to grade the washed material. The efficiency of the unit may be judged by the fact that a single cylinder of this design with screens has been installed with a guaranteed output of 640 tons per day.

The stone-crusher on the stand is of the Acme-

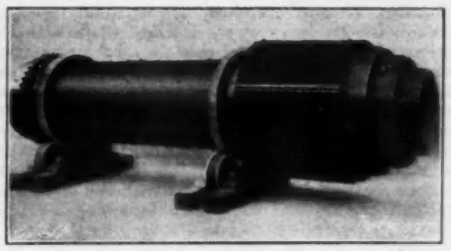


FIG. 16—GRAVEL WASHER—GOODWIN

Victor type, and has a machine-cast steel body and jawstock. There are some concrete mixers and other builders' machinery.

HOLDEN AND HUNT.

Spot and butt welders are to be seen in operation on the stand of Holden and Hunt, of Cox's-lane Works, Old Hill, Staffs. The firm's No. 1 spot welder, shown in Fig. 17, has a transformer rating of 4 kW. and will weld mild steel and iron of 20 S.W.G. added thickness or $^{5}/_{64}$in. added thickness at intervals. A four-way voltage regulator and automatic trip switch are provided. For the operation of these machines single-phase current is required, but they can be connected to one phase of a two or three-phase supply. When direct current is provided by the supply undertaking or by a private plant a converter must, of course, be installed. The machine is controlled by a foot pedal at the front of the welder. For short periods the machine will stand heavy overloads without damage. The machine and electrodes are water cooled, the water connection being made by a special

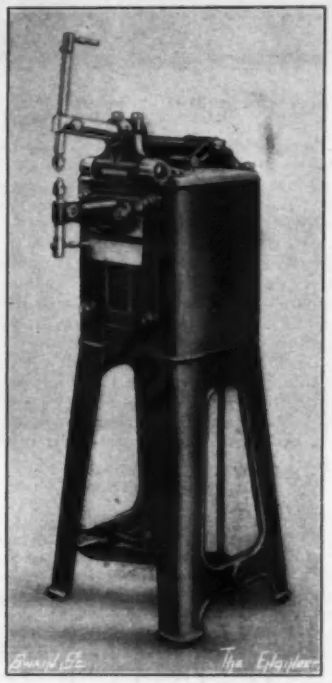


FIG. 17—SPOT WELDER—HOLDEN

¼in. rubber tube. The only costs in connection with these machines, apart from the operator's wages, are those of the current and the small flow of water for cooling purposes. The following consumption figures, we are informed, are actual meter readings taken over a large number of welds :—

Single metal thickness in iron and steel.	Added thickness in inches.	Units per 1000 welds approx.	Time of welding in secs.	Diameter of spot.
34 S.W.G.	0·0184	0·2	0·25	$^{1}/_{16}$
30 S.W.G.	0·0248	0·3	0·25	$^{1}/_{16}$
28 S.W.G.	0·0296	0·5	0·3	$^{5}/_{32}$
26 S.W.G.	0·036	0·8	0·4	$^{3}/_{32}$
24 S.W.G.	0·044	1·0	0·4	⅛
22 S.W.G.	0·056	1·3	0·5	⅛
20 S.W.G.	0·072	1·5	0·5	⅛

The figures show that the cost of current is very small and that the welds are made rapidly.

THE CROSTHWAITE FURNACE AND ENGINEERING COMPANY, LTD.

A mechanical stoker for Lancashire boilers is exhibited by the Crosthwaite Furnace and Engineering Company, Ltd., of York-street Ironworks, Leeds. This furnace is of the forced draught type with hollow bars. The bars are arranged transversely and have holes cast in them to form passageways for air, which is forced into them by steam jets and escapes up narrow passages between the bars into the fire. It is prevented from going down into the ashpit by spigot and faucet joints. Other holes cast in the bars form continuous passages through which air passes, under natural draught, to the bridge for secondary combustion. It is naturally heated in the passage.

In the stoker, see Fig. 18, the fuel is fed into hoppers A at the bottom of which is a feeder slide B. This feeder slide has a forward and backward motion actuated by a cam C on the driving shaft D. By means of a simple arrangement of screw and nut, the stroke of the feeder can be easily regulated to suit the rate of combustion required, without stopping the stoker.

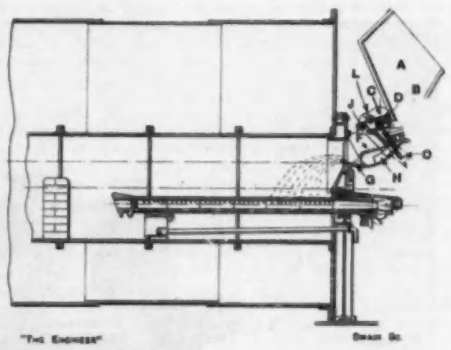


FIG. 18—MECHANICAL STOKER—CROSTHWAITE

The fuel, in small quantities, is pushed by the feeder over the edge of the feed-box F on to the firing nose G, being divided during the process. The fuel is then thrown on to the grate by means of the swinging shovel H, which is carried by a single central arm J swinging in a passage directly through the centre of the feed-box. The swinging arm is carried on a horizontal shaft, which also carries at one end a curved cam lever L, with a nickel chrome steel roller, and at the other end a spring lever. To this lever there is attached a tension spring O, which is, in turn, anchored to a bracket on the feed-box. The curved cam lever is operated by a three-point finger cam, mounted on the driving shaft D. This cam is not keyed to the shaft, and is therefore free to rotate in advance of its normal position on the shaft. When the cam is bringing the shovel to the back position against the tension of the spring, it is driven by a pin from the feeder cam C, and immediately the roller reaches its extreme limit the cam flies forward, thus giving the cam lever freedom to swing clear of the cam, and give the spring full play to actuate the shovel.

ENGINEERING SPECIALISTS, LTD.

A variety of valves in both forged steel and gun-metal is shown on the stand of Engineering Specialists, Ltd., Craven House, 121, Kingsway, London, W.C. 2.

The peculiarity in these valves is the design of

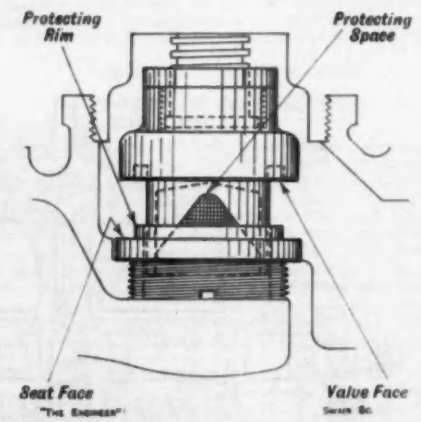


FIG. 19—STEAM VALVE—ENGINEERING SPECIALISTS

the "clack," which is illustrated in Fig. 19. Depending from the clack there is a skirt, or sleeve, which is a fair fit inside the bore of the seating. In the sides of this skirt there are cut triangular holes for the passage of the steam. The apices of these holes are below the face of the valve proper, so that no appreciable amount of steam can pass just as the valve is about to be opened or closed and, consequently, cutting of the faces is avoided. An extra protection is provided by the steam being deflected straight outwards, and there is a projecting rim to protect the seating face. The triangular shape of the openings also has the advantage that it provides for a very fine adjustment of the flow of steam. The clacks and seats are machined out of

a solid bar of stainless steel. These valves are made in sizes ranging from ¼in. up to 3in.

CROSSLEY BROTHERS, LTD.

The exhibit of Crossley Brothers, Ltd., of London and Openshaw, Manchester, includes examples of

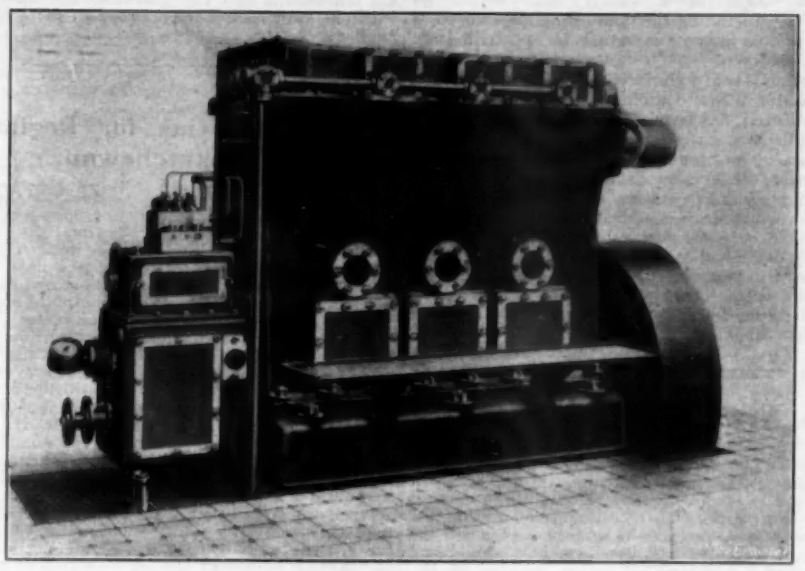


FIG. 20—THREE-CYLINDER COMPRESSORLESS OIL ENGINE—CROSSLEY

vertical and horizontal types of heavy-oil engines, all of which are shown working. Fig. 20 represents one of the exhibits, a three-cylinder vertical compressorless oil engine, which is shown direct coupled to a 50-kW, 220-volt D.C. dynamo running at 450 r.p.m., supplied by the General Electric Company, Ltd., of Witton. The engine has a cylinder bore of 8¼in. with a 12in. stroke. At full load output the working costs for fuel and lubricating oil are stated to be less than 15d. per hour, or about 0·3d. per unit generated. This particular engine is representative of a series of units built with two to six cylinders with designed outputs up to 400 B.H.P. A feature of the design is that all the moving parts are supplied with forced lubrication and no hand oiling is required. The engine is started from cold by means of compressed air. All the valve gear is arranged overhead and it is driven by a chain working in a bath of lubricating oil. The fuel pumps are also gear driven and they are grouped together in one compact and accessible unit at the governor end of the engine. Although the engine is of the totally enclosed type, easy access is afforded to all valves and fuel atomisers by sliding backwards a light aluminium cover plate, one movement of which completely exposes the cylinder heads and the valve gear.

Two horizontal engines are exhibited, one with two and the other with four cylinders of 8in. bore and 12¾in. stroke, which have designed outputs of 48 and 88 B.H.P. respectively. They are of the totally enclosed cold starting type and are specially designed for industrial services, electric lighting and pumping. The lubricating system is automatic and, with the exception of the ring-oiled main bearings, all parts are supplied with oil under pressure which is in continuous circulation. These engines are arranged for compressed air starting, and on the stand one of the firm's oil engine driven compressor starting sets is shown. It comprises a 3½ B.H.P., 4½in. bore by 5in. stroke engine coupled direct to a 3½in. bore and 4½in. stroke air compressor running at a speed of 650 r.p.m. The set is designed to charge the air receiver up to a pressure of 350 lb. per square inch.

The engine which we illustrate in Figs. 21 and 22 is a new design which has not previously been shown at any exhibition. This model is a single-cylinder horizontal heavy-oil engine with a normal rating of 15 B.H.P. at 400 r.p.m. It has a cylinder bore of 6½in. and a stroke of 13in. This engine is typical of a new series of small horizontal engines built in sizes of 9, 11, 13, and 15 B.H.P. respectively. As Fig. 22 indicates, the design has been carried out on similar lines to the larger Crossley open type horizontal oil engines. The bed-plate is fitted with a separate liner which is held in position by the cylinder head or breech end and is also supported at the front end in the bed-plate casting. The water jacket spaces around the liner are large and the cooling water enters and leaves by stream-lined passages. Long studs are used to bolt the breech end to the bed-plate, and these serve to tighten the liner joint.

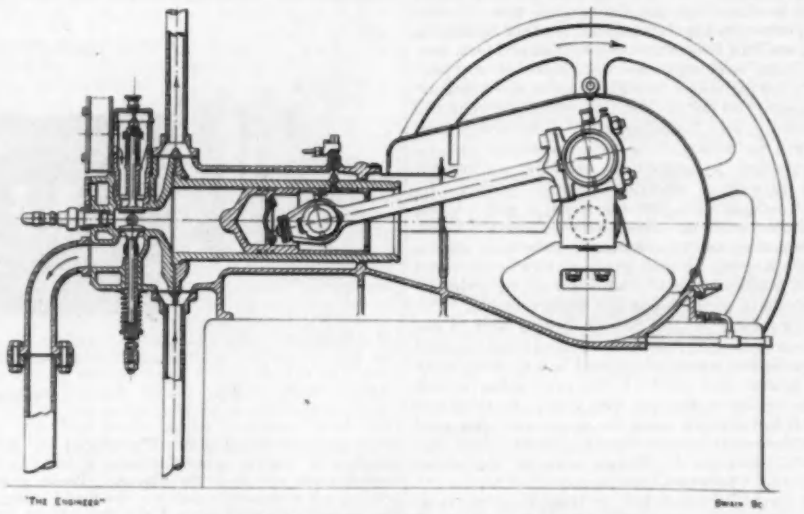


FIG. 22—SECTION OF 15 B.H.P. OIL ENGINE—CROSSLEY

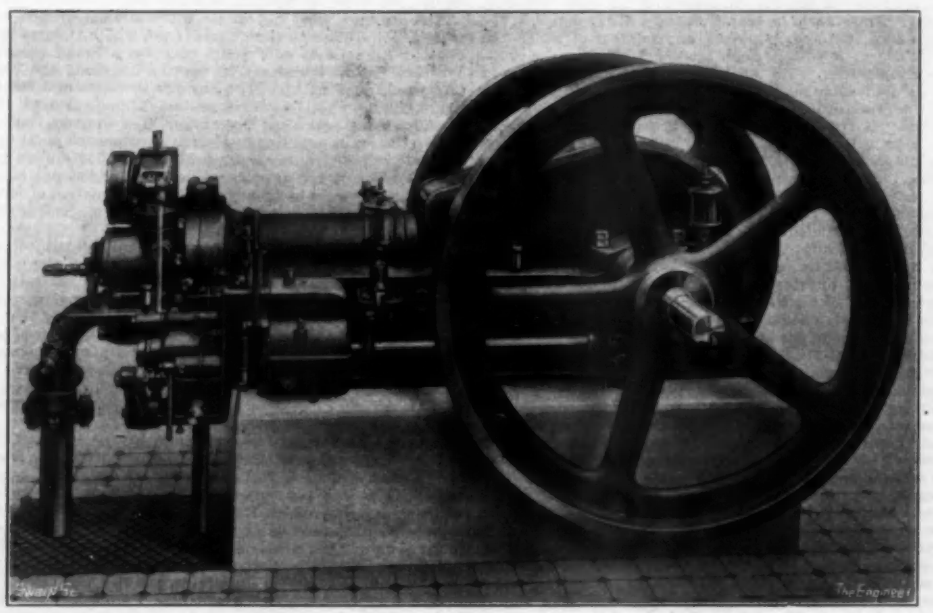


FIG. 21—15 B.H.P. HEAVY OIL ENGINE—CROSSLEY

The arrangement of inlet and exhaust valves is the same as that in the larger engines, and the inlet valve has a detachable cage, to which the air silencer is bolted. The exhaust valve is placed immediately below the inlet valve on the same vertical centre. Specially large ports and passages are provided. The fuel atomiser is arranged at the centre of the breech end and the sprayer is of the multi-jet type with a glandless spindle. Both the fuel pump and the governor are grouped together to form one unit. The pump is of steel with a cast iron liner and a steel plunger. The principal working parts, including the fuel cam and the fuel pump lever, work in an oil bath, as does the governor gear, which actuates the fuel valve. Although all the parts of the governor are entirely enclosed, a lid affords complete access to them. As will be seen from Fig. 22, the piston is exceptionally long and it carries double rings in each of the three grooves, which, we understand, maintain good compression. The design is so contrived that any sludge or oil escaping from the piston mouth does not mix with or contaminate the lubricating oil escaping from either the connecting-rod big end or the main bearings. That oil can be collected from the base of the crank chamber and after filtering is again ready for use. A fuel oil heater forms a standard part of the equipment and permits of a wider range of fuel oils than might otherwise be possible. The engine can be started by hand direct on fuel oil, no heating lamp being necessary, but only a lighted wick, which enables the engine to be started from cold after a few turns of the starting handle. The full load fuel consumption for this new engine when running on Diesel oil is said to be 0·45 lb. per B.H.P. per hour.

(To be continued.)

Tidal Energy.

(From a Correspondent.)

THE problem of how to convert into a commercial product some of the enormous energy represented by the masses of sea water which continually rise and fall around our coasts during each tide has for years interested our engineers. Those who have attempted to deal with the subject, while they know that the energy can be harnessed in certain special circumstances, realise that the first essential is to show that the power so gained is able to compete in cost and utility with power produced from coal or oil. Of the various methods hitherto suggested for abstracting power from the tides the basin system only has survived criticism. This system proposes to shut off parts of the sea and use the areas so enclosed as reservoirs in which the water levels can be regulated by letting the tidal waters flow in or out as desired. The differences in level and the movement of the water consequent on these differences will thus become the means of the production of power. Such reservoirs can be created by shutting off bays or estuaries by dams, and in these structures turbines can be inserted through which the water flows. Where bays are too wide at the mouth or too deep the damming may be impracticable or the cost may be prohibitive. The range or height of tide, varying as it does from point to point on the coast, is further a most important factor in regulating the volume and

the economical production of commercial power from tidal energy.

These considerations greatly restrict the number of possible sites where power may be developed. Fortunately, however, there are a few bays or estuaries in Great Britain and Ireland where the circumstances are favourable, and of these the most suitable for immediate development is the estuary of the Severn. The direct and consequently intermittent power developable there and elsewhere, however, no matter how cheaply it can be produced, is hardly saleable in its intermittent form. Engineers, therefore, have devoted themselves to the question of how to store in some manner a portion of the intermittent supply, so that this stored portion may be readily available at the times when the direct supply from the tides is small or fails altogether, as it does when the water levels in the reservoirs and the sea become equal.

Three methods of accomplishing this object of turning the intermittent supply into a continuous one have been devised, and it is understood that schemes are being proposed for the Severn which utilise each of them. These methods are :—

(1) The construction of a masonry dam across the estuary and, in addition, the formation of a reservoir or reservoirs in the valleys of the adjacent high or hilly ground. During the hours of each tide, when plenty of power can be developed from turbines placed in the dam, a portion of the power is to be used to pump water up to these hill reservoirs. By releasing this water a part of the initial power can be recovered by the use of suitable machinery at the times when a supply cannot be got directly from the tides, and thus enable a continuous supply of power to be provided. It is believed that this is the method which has been studied by the Commission appointed by the Government to examine the possibilities of the Severn. It obviously entails the construction of expensive subsidiary works in addition to the damming of the estuary.

(2) Mr. Shishkoff has patented an adaptation of the heat accumulator to the special case of conserving power obtained from tidal or other hydraulic sources, see THE ENGINEER, Sept. 26th and Oct. 3rd, 1930. These accumulators will store steam produced by an ingenious modification of an hydraulic brake inserted on the main driving shaft between the water turbine and the alternator. The steam thus stored will be available to drive a steam turbine direct coupled or geared to another alternator, thereby providing electrical energy during the "dead" periods when the difference in water levels is insufficient to secure direct power from the tides. The promoters of this scheme, however, realise that the efficiency of their project may be low, and therefore contemplate the addition of an ordinary steam plant to supplement the accumulators. The scheme proposed for the Severn is also said to use only one-way flow turbines ; as a result the demand on the ordinary steam plant and the accumulators will be heavy, and as the latter give a low return in power for the energy put into them, the total loss on the tidal system must be great and the continuous electrical power supply possibly may not exceed 25 per cent. to 30 per cent. of the power developed by the water turbine.

(3) A Swiss engineer, Mr. A. Huguenin, M. Inst. C.E., has devised a system by which, it is claimed, the minimum of cost is accompanied by the development of the maximum power. The patent rights of this system for the British Empire are held by Tidal Energy, Ltd. (T.E.L.), a company formed in London to develop the patents, Sir Murdoch MacDonald and Partners acting as consulting engineers. Under this system a part of the power of each tidal movement will be used to compress air into suitable containers. The air so compressed can be released again as desired, to drive the plant when the main power from the tides is no longer available at the "dead points." The efficiency of the storage plant alone is said to be in the neighbourhood of 55 per cent., and owing to patented double-flow turbines being used, power is obtained both from the incoming and outgoing tides, consequently it is only necessary to store a relatively small amount of power to cover the "dead" periods. The double-flow turbines of the type proposed have the further advantage of permitting the turbine casings to be used as sluices completely open or completely shut as may be required.

The complete system is estimated to have an overall efficiency of approximately 80 per cent.; that is to say, over 80 per cent. of the power produced by the water turbines can be transformed into electrical energy.

It is understood that a scheme for the Severn, based on this compressed air T.E.L. system, will shortly be submitted to the Government for its consideration and for the purpose of securing the necessary permission to erect the requisite plant.

The proposed dam, with its sluices, locks, and turbines complete, would so cross the Severn that it would be possible to utilise the dam as the basis of both a road and railway bridge over the estuary.

The scheme is also so devised that it can be carried out in two or more stages, the difference between them being the number of turbines and generators, &c., which may be installed. From the first and smallest scheme now proposed for construction there would be available for supply to the main grid system of the country a constant diurnal load of nearly 80,000 kW, or about 1,900,000 kWh per day. In addition to the steady load from this first stage there would be available for sale a further fluctuating load, a considerable part of which at least could be used in the general grid system. The output of the last or completion stage as a steady load would be 280,000 kW. Including the fluctuating load the total energy available in any year would be approximately 3,500,000,000 kWh.

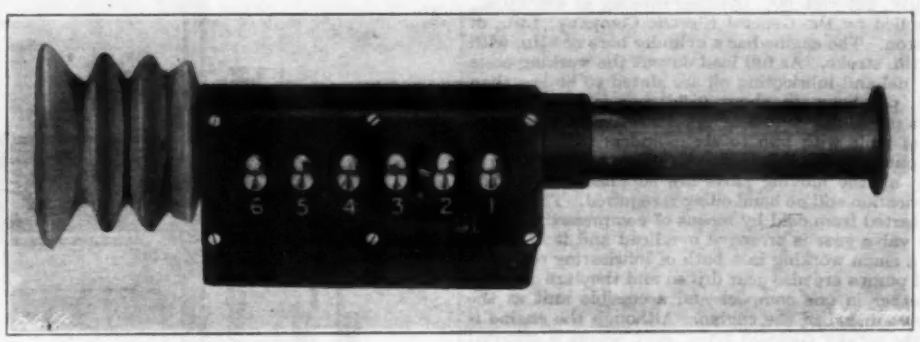
The scheme is said to have the advantage that each of the patents, whose combination is to produce the results indicated, has been utilised separately already for other purposes ; thus the value of each of them is well known. The promoters are so confident of the correctness of their views that they have decided to erect a preliminary station at their own expense simply for demonstration purposes, where the value of the whole or each part of their system can be thoroughly examined by those interested. Engineers and others will be given the fullest opportunity to watch and test the results.

We look forward with interest to seeing the detailed plans of this scheme.

A New Visibility Meter.

THE word "visibility" has several meanings. It can, for instance, mean the maximum distance at which an object can be seen, or it may be used in the sense of describing how distinct an object appears to the eye. In order to provide some definite scientific measure of the latter type of visibility, C. F. Casella and Co. are putting on the market a new visibility meter, invented by Mr. M. G. Bennett, of the Air Ministry, Meteorological Office. The problem of measuring this quantity does not depend solely on the lighting and distance of the object viewed, because contrasts of colour or of light and shade have an appreciable effect.

The new instrument works on the "extinctive" method.



BENNETT VISIBILITY METER

The artificial obscuration is produced by means of a number of slightly ground glasses which can be placed between the eye and the object. These ground glass screens are mounted in holders, the first having one glass, the second two glasses, and the third three, and so on. From the photograph which we reproduce, it will be seen that there are a number of finger switches on the side of the instrument, numbered consecutively from one to six. These switches on being depressed bring the ground glass screens across the field of view, and the numbers refer to the number of screens incorporated in each separate holder. Thus it will be seen that there are included in the instrument twenty-one glasses, any number of which can be in use at a time. Each glass has exactly the same obscuring power. The switches are conveniently placed for the first three fingers of each hand to work them. In use the procedure is as follows :—The object of which the visibility is required is sighted through the instrument. No. 1 hand switch is depressed, bringing the first screen into play. If this is insufficient to obscure the object, it is released and No. 2, which, having two screens, has double the obscuring power, is brought into position, and so on until the object can no longer be seen. If No. 6, with six glasses, is insufficient, this switch is left in the depressed position, and those controlling lesser numbers of glasses are again tried in order. When the object has been obscured, the numbers of the switches in use are added together, giving a measure of the visibility according to the scale of instrument. If the twenty-one glasses supplied are not sufficient, an attachment containing another ten can be fitted into the eye-piece to increase the range of the intrument to thirty-one, which is sufficient for every purpose.

Various precautions have been found necessary to ensure accurate readings. When light from any object other than that being tested falls on the glasses, a proportion is scattered into the eyes of the observer, producing an additional amount of obscuration. Similarly, light entering the eye other than that coming through the instrument has the effect of making the object less visible. To overcome these difficulties a sliding tube has been fitted to the object end of the instrument, and a rubber eye-piece is provided at the other end. Any possibility of reflection from the surfaces inside is removed by lining the instrument with black velvet. When not in use the sliding tube can be pushed back into the body of the instrument, in which place it locks the glasses in the "off" position.

The possibility that moisture might be deposited on the glasses has been guarded against by inserting a plain piece of ordinary glass in both the eyepiece and the object tube. The makers state that though it is theoretically possible for moisture to be produced by the condensation of the air enclosed in the instrument, no trouble on this account has ever occurred.

The scale of any visibility meter is arbitrary, but it is interesting to note in connection with this intrument that the makers declare themselves able to produce glasses of uniform and repeatable obscuring power. Each glass is tested separately before being placed in the meter against an object of consistent visibility. Consequently, all the instruments have the same scale and readings taken with one are strictly comparable with those taken with another.

Natural Gas for Regina, Saskatchewan.

As we have already briefly announced, the City Council of Regina, Sask., has approved the proposals of Tri-Cities Utilities, Ltd., for the supply of natural gas. The engineers of the company are now starting work on the surveys connected with the construction of pipe lines, and, providing that the necessary by-law is approved by the ratepayers of the city, it is hoped that some of the construction work may be accomplished during the winter.

The company named proposes to pipe natural gas to Saskatoon and Regina from the Kinsella-Wainwright field in Alberta, the reserves in sight in that area being, it is believed, sufficient to warrant the construction of a pipe line from Kinsella to Regina, a distance of about 370 miles.

The city's consulting engineer, Mr. R. H. Davis, in recomending Kinsella as one of the two suitable districts for the supply of gas to Regina, stressed the possibility of a gas field extending from Viking to Wainwright, Alberta, a distance of some 40 miles. In the Wainwright-Fabyan area, oil drilling has disclosed at least eighteen wells with a total daily open flow of over 100,000 million cubic feet, the gas in these wells in most instances being mudded off and drilling continued deeper in search of petroleum. Twelve miles north of Kinsella and about an equal distance east of the Viking field the Messabe Oil and Gas Company has completed a well producing dry gas with a rock pressure of 760 lb. and an open flow of about 25,000 million cubic feet a day.

The contracting company, Tri-Cities Utilities, Ltd., is stated to have gas purchase agreements covering a total of 66,560 acres, mostly in the vicinity of the Kinsella well, and four gas wells on the leases, one of which has an initial open flow of 21,700,000 cubic feet. Reserves of 96,000,000 million cubic feet are estimated for the area under contract, and further drilling is expected to develop greater reserves. In this connection it is interesting to note that the Viking field, just west of Kinsella, has been supplying the city of Edmonton since 1923. The initial reserves in this particular field have been estimated at between 60,000,000 to 80,000,000 million cubic feet.

The proposed pipe line for Regina would therefore come from a point close to the district from which the gas line runs to Edmonton, and would traverse a broad area in Western Saskatchewan. The cost of installing the pipe line would depend upon the number of cities and towns made tributary to the system, and might depend upon the decision to be taken by Saskatoon. The average cost of laying the main pipe line to Regina is estimated at 21,000 dollars per mile, representing nearly 8,000,000 dollars for that portion of the project alone. An additional large expenditure would be incurred in the construction of local distribution systems either in Regina or Saskatoon, neither of which cities has yet a gas supply.

The rates to be paid by consumers will be subject to negotiations before the agreement is drawn up, the company's offer being on a gradually decreasing scale from 70 cents per thousand cubic feet for small consumers to about 46 cents for large consumers. It is possible that a schedule may be drawn up under which a consumer of up to 4000 cubic feet a month may pay 70 cents a thousand cubic feet. For the next 96,000 cubic feet 50 cents a thousand cubic feet would be charged, making domestic consumption for house heating in all except the largest residences economical.

Special attention has been devoted by the Regina City authorities to the possibility of obtaining natural gas from the Turner Valley field in Alberta, where gas is being produced at the present time at an estimated rate of 80,000,000 million cubic feet per annum, equivalent to at least 4,000,000 tons of coal on the basis of heat value. Only about 10 per cent. of this gas is being utilised, the remainder after extraction of the naphtha being allowed to go to waste. The consulting engineer to the city, however, does not approve connection with the Turner Valley field, feeling that uncontrolled drilling may hasten exhaustion of the gas, resulting in an interruption or cessation of the city's gas supply. A pipe line from Turner Valley, furthermore, would cost about £1,000,000 more than one from Kinsella.

Railway and Road Matters.

OWING to ill-health, Mr. James Pepper has felt compelled to retire from the position of secretary and general manager of the Belfast and Northern Counties Committee of the London, Midland and Scottish Railway. Mr. Pepper is being succeeded by Mr. Malcolm S. Speir, assistant to the general superintendent for the Northern Area.

IT was stated in the House of Commons by Mr. Morrison on February 11th that it was hoped to bring the street traffic signals in Oxford-street into use in the near future. He added that on the advice of the London and Home Counties Traffic Advisory Committee proposals were under consideration for their installation at eleven other junctions.

A FEATURE about the Morden extension of the London Electric Railways, on which we commented favourably when the line was opened in September, 1926, was the provision of a garage at the Morden terminus with the idea that car owners, instead of going by car all the way to and from town, would garage their cars at Morden and travel the rest of the way by tube. This course has now been followed by the London, Midland and Scottish Railway at 79 suburban stations in the London, Birmingham, Manchester, and other busy areas.

THE notice in the Press as to possible delays owing to the works at Romford, L. and N.E.R., mentioned herein on February 13th, drew forth a letter in *The Times* of January 31st, fearful that the results would not be as happy as the railway anticipated. The same correspondent has, however, since written a further letter saying that passengers have been agreeably surprised that the delay on most trains has been so slight. The writer proceeded to say that "railway companies suffer much criticism, and it is only just that we should acknowledge the fact that, in this instance, praise is due to them for the manner in which they are overcoming considerable difficulties."

THE International Labour Office at Geneva has received a report from its Committee on the subject of automatic couplings to the effect that the adoption of a uniform and adequate automatic coupling would contribute to the prevention of accidents on railways in countries where screw-coupling is in general use, and that it seems technically possible to devise such a coupling. As showing what little need there is for automatic couplings for screw-coupled stock in this country, we would say that the annual reports of the Chief Inspecting Officer of Railways show that, during the five years 1925–29, only 13 men were killed when using screw-couplings, or less than three a year.

SPEAKING recently at Burnham-on-Crouch, Mr. Morrison was saying he hoped that the facilities given to the railway companies for co-ordination with road transport would not encourage the railways to feel that there was no longer as much need for intensive effort in improving efficiency, comfort and economy. Assuming that there was an important future for railways, they must not expect them to give of their best if traffic, that they were eminently fitted to carry, was diverted from them to congested highways, which cost a large amount of public money to construct and maintain. On the other hand, the companies must not expect to retain the traffic unless they tightened every screw and exerted every effort to make themselves popular and acceptable to the travelling public. Mr. Morrison concluded: "I would encourage, and even protect, the efficient, if it is in the public interests to do so, but I would not lift a finger to help those who are not energetic in helping themselves."

THE Ministry of Transport railway statistics for November, when compared with the corresponding month of 1929, show a falling off of 5·9 per cent. in the number of passenger journeys and of 9·2 per cent. in the receipts from passengers. What is now remarkable is that, whereas formerly the variation was a decrease in ordinary fare-paying passengers and an increase in those travelling at reduced fares, there is now a greater drop in the latter than in those paying full fares. The respective decreases are 2,981,735 for reduced fares and 2,817,972 for full fares. The reduction in passenger train mileage was, however, only 2·8 per cent. The freight tonnage decreased by no less than 14·4 per cent.; the freight receipts by 12·7 per cent., and the freight train mileage by 10·2 per cent. The average train load, moreover, fell from 133½ to 131¼ tons, but, apparently, owing to the less business, the traffic moved more quickly, and the net ton-miles per engine-hour rose from 443½ to 457½.

THE annual report for 1930 of the Southern Railway has, in its introduction, the announcement that the first stage of the docks extension scheme on the river Test at Southampton, is making good progress, and that a portion of the new accommodation will be brought into use during the ensuing year. The capital expenditure for the year was £1,301,195, of which £468,978 was for lines, £58,918 for rolling stock, £228,530 for new steamers, and £615,141 for docks. It is proposed to spend £2,837,000 on capital account this year, of which £900,000 will be on electrification, £280,000 on improvement of stations, and £1,550,000 at Southampton Docks. The receipts from railway business were £22,395,927, as compared with £22,992,509, and the expenditure therein was £17,928,351, as against £18,174,507. For the whole undertaking the receipts and expenditure were £25,890,140 and £20,701,719, as compared with £26,507,018 and £20,914,249 respectively, and the net receipts thus were £5,188,421, as against £5,592,759. The addition of miscellaneous receipts and the reduction of miscellaneous charges brought the net revenue for last year up to £6,133,927, to which had to be added £161,886 brought forward, and this allowed for a dividend of 5 per cent. on the preferred ordinary stock and of 1¼ per cent. on the deferred ordinary stock—the former was at the same rate as in 1929, but the latter compared with 2½ per cent.—and for £93,410 to be carried forward. The number of passengers carried rose from 208,837,904 to 216,523,392, of which increase over 5 millions were in the third-class, and 2,600,000 in workmen. The freight tonnage fell from 17,759,514 to 17,346,631. There was an increase of 1,700,000 electrically operated passenger train miles, but it should be noted that, notwithstanding, the steam-worked passenger train miles also increased by 120,000 miles.

Notes and Memoranda.

THE official returns rendered to the Electricity Commissioners show that 1141 million units of electricity were generated by authorised undertakers in Great Britain during the month of January, 1931, as compared with the finally revised figure of 1079 million units in the corresponding month of 1930, or an increase of 5·7 per cent.

IN an article in the *S.A. Mining and Engineering Journal* Mr. J. G. Finlay discusses geothermic gradients, and points out that while the average temperature rise is 1 deg. Fah. for every 72ft. descent into the earth, there are some notable exceptions from this rule. In the Comstock lode, in Nevada, the rise is 1 deg. per 33ft., while in the Lake Superior copper mines it is 1 deg. per 250ft., and in the Pas de Calais 1 deg. per 110ft. The author puts forward several theories to account for these variations.

NEAR Edinburgh there is an electrified poultry farm stocked with 200,000 laying hens. There are nine incubators, each of which will hold 16,000 eggs. They are kept at a temperature between the limits of 99·5 deg. and 100 deg. Fah. by means of electric heaters of 2400 watts each. An ingenious mechanism is used to turn the eggs automatically every six hours. The laying sheds are electrically lit and electrically driven conveyors are used for the food, which amounts to 150 tons a week.

THE total export of tungsten ores from the Federated Malay States in 1929, states the annual report of the F.M.S. Mines Department, was 5441 pikuls (323·8 tons), as compared with 84 pikuls (5 tons) in 1928. This increased output was due to the enhanced price of the commodity. The exports of wolfram and of scheelite were 742 pikuls and 4699 pikuls respectively. In 1927 the exports of wolfram had been 336 pikuls, and in 1928 84 pikuls. There had been no export at all of scheelite in either 1927 or 1928.

A STRIKING advance in lighting developments was recently announced by Leroy P. Sawyer, vice-president of Claude Neon Lights, Inc., New York, in connection with the production of rare gas tubes to operate on standard 110–220-volt circuits. By suitable mixtures of gases and improvements in electrode design, a wide range of colour effects is produced, with uniform flux distribution, full daylight effects, increased efficiency of operation and added life of units. The cathode is initially heated by a 6-volt coil, which is cut out of circuit automatically after the luminous discharge starts. According to the *Electrical World*, the new low-voltage tubes have attained a luminosity as high as 2000 lumens per foot compared with 60 to 132 lumens per foot for high-voltage luminous tubes. They are adapted to commercial, industrial and special residential applications, notably in panel and recessed units.

IT seems highly probable, says *Nature*, that in a few years' time much of our electric lighting will be done by incandescent gases in luminous tubes and not by incandescent filaments. This kind of lighting is generally referred to as neon lighting, but argon, helium, krypton, and other gases are used. Although Lord Rayleigh and Sir William Ramsay were the first to separate these gases from the atmosphere, yet the commercial development of them for lighting purposes is mainly due to Georges Claude in France. There are now about a hundred companies in various parts of the world exploiting his patents and all bound together by an agreement to interchange technical information and research results. The original voltage used was 32,000, but it has now been reduced to 1000, and tubes have been made in the laboratory that will work at 200. At present their most important use is for the lighting of aerodromes and air routes. The light from Croydon beacon can be seen by airmen when flying over France.

IT is quite natural that with the increase of complexity which characterises modern methods in nearly every subject, increased specialisation has become necessary. One outcome of such specialisation is the subdivision of the "Transactions" of the American Institute of Mining and Metallurgical Engineers into a number of separate divisions. This system has, remarks *Nature*, its drawbacks as well as its advantages. In the older volumes were to be found papers dealing with every branch of the whole wide subject, and an engineer interested in one section only, who turned over the volume to find papers on his special branch, could scarcely help seeing the others. He might even be induced to read them, and would probably find that every paper, however remote its subject might appear to be from the particular subject upon which he was engaged, would, nevertheless, throw some new light upon it, and prove of some assistance to him. This advantage he now loses under the new method. His knowledge of the individual subject may, no doubt, become more profound than it was, but he necessarily loses that breadth of outlook which is one of the most valuable qualities that an engineer can cultivate.

THOSE responsible for the marketing of marine storage batteries have occasionally met with the criticism that violent movements of a ship in a seaway may have a bad effect both on the contents of the battery and upon its output. Whilst it has been possible to make a general denial of these criticisms, and whilst such denial was made in all good faith theoretically, not until recently has any test been made to determine just what would happen. The Chloride Electrical Storage Company, of Clifton Junction, Manchester, has recently carried out exhaustive tests in which the output of a group of Exide Ironclad cells was measured with the cells tilted to various angles. The results of this experiment were most successful, showing that over 60 per cent. of the rated capacity was obtained in all positions of the cells up to a total inversion, whilst up to 60 deg. of tilt there was no loss of the electrolite. It is felt that such tests as these are infinitely more violent than anything which is likely to be experienced in the very worst storms, and, in addition, it should be remembered that quite a number of serious marine casualties occur through ships running aground, and in such cases there is little, if any, motion of the ship at all. It is, of course, on such occasions that the standby lighting batteries are called prominently into use.

Miscellanea.

A NIGHT flying air mail service has been organised in Canada between Calgary and Winnipeg, with stops at Lathbridge, Medicine Hat, Moose Jaw, and Regina. It is said that the air ports can be seen at night at a distance of 80 miles.

WORK has been started on the construction of the Wenatchee hydro-electric power plant on the Colombia River, Washington. It is to have a capacity of 240,000 horse-power, is to cost 28,000,000 dollars, and the first four units are expected to be at work in August of 1932.

IN 1929, states the annual report of the Federated Malay States Mines Department, the oil consumed for fuel on mines in the Federation increased by 7256 tons, while coal so used decreased by 1272 tons, and wood by 39,926 tons. The position is accounted for by the great and increasing use of the oil engine by the Chinese.

FIGURES issued by the Southern Railway show that the tonnage of coal carried by rail from the collieries at Chislet, Tilmanstone, Snowdown and Betteshanger during 1930 amounted to 1,046,247 tons. Of this quantity, over 25 per cent. was for the Southern Railway Company's own use. The bulk of the remainder was used in cement and paper works in Kent.

IT is contemplated that a large chemical fertiliser plant should be constructed on property owned by the Saint John, New Brunswick, Harbour Commissioners. The Amsterdamsche Superfosfaafabriek, of Utrecht, Holland, and Fison, Packard and Prentice, of Ipswich, England, are reported to be associated with the International Fertilizer Company, Quebec, P.Q., in the enterprise.

THE thirty-sixth general meeting of the Deutsche Bunsen Gesellschaft für angewandte physikalische Chemie will take place from May 25th to 27th, 1931, in Vienna. The subject of the symposium will be:—"Recent Progress in the Science of Metallurgy, with particular reference to Light Metals." The arrangements have been undertaken by Geheimrat Prof. Dr. Specketer, Director of the I.D. Farbenindustrie A.-G., and managing director of the Griesheim Elektron Works.

AS a result of a conference held at Ottawa on January 27th by the officials of the Department of Railway and Canals, and representatives of the shipping interest, it was decided to make test shipments of grain to the amount of 750,000 bushels in two, or possibly three, cargoes from the Port of Churchill on the Hudson Bay next September. The Hon. Dr. Manion, Minister of Railways, was assured that from present indications the port facilities would be sufficiently advanced to admit of the test movement by about the middle of September, the date by which the contractors for the elevator have agreed to complete their work.

AN interesting and very commendable feature has been introduced in connection with the Bury electricity undertaking. The staff of the Chamber Hall power station has organised an "Improvement Class" for the staff and employees at the power station. Two useful and informative lectures have already been given by Mr. Vernon Walker, on "Boilers and Combustion." It is hoped that further lectures on different sections of power station plant will be arranged during the winter session. By permission of the Electricity Committee and the general engineer and manager, Mr. J. G. Potts, the demonstration room at the showroom is being used as a lecture hall on these occasions.

THE Department of Overseas Trade is informed by the Commercial Counsellor to H.M. Embassy at Washington that the Carnegie Institute of Technology has announced that a Third International Conference on Bituminous Coal will be held at Pittsburg from November 16th to 21st next. The purpose of this meeting is to present for discussion the results of recent studies on coal, emphasising improved methods of utilisation and their economic value. The programme will include papers on the carbonisation, liquefaction and gasification of coal; by-products; the mechanism of combustion; cleaning of coal and its preparation for the market; pulverised fuel power plants; domestic heating, &c.

AN exhibition of the mineral resources of the Empire was recently opened at the Imperial Institute, South Kensington, by Mr. Amery. Mr. Amery, who was introduced by Lieutenant-General Sir William Furse, Director of the Imperial Institute, described the present age as an age of metals, especially of heavy metals, an age of alloys, after the legendary ages of gold, silver, bronze and iron. Metals and minerals unknown in the main a generation ago—such as chromium, nickel, tungsten and manganese—were playing an immensely important part in this age, said Mr. Amery, and it was worth asking how the British Empire was situated. Our position was fortunate. Together with America we produced two-thirds of the total world mineral output of some 2,000,000,000 tons. Something like 45 per cent. of the annual Empire production—valued altogether at nearly £400,000,000—came from this country, which was still the most intensively developed mineral area in the world.

A FEW days ago, Mr. Archibald Allison, of Sheffield, delivered a lecture at Dudley on "Chilled Iron Rolls," before the Staffordshire Iron and Steel Institute, Birmingham Metallurgical Society and local section of the Institute of Metals. The lecturer paid tribute to the craftsmen of the past, who, without knowledge of chemistry or pyrometry, successfully performed this difficult manufacture. After pointing out the exceptional character of roll production, Mr. Allison dealt with methods of melting and the characteristics of the materials required. He particularly stressed the scope for new melting appliances, particularly some heat machine capable of dealing with pieces of large size and heavy weight, such as large scrap rolls, and at the same time possessing flexibility of operation. The lecturer dwelt upon the value of the chill test, and stressed its value as applied to other irons. The qualities of chilled rolls and requirements for different purposes were discussed, and the need for low carbon contents was emphasised, particularly for such exacting demands as the hot rolling of steel strip, tin-plates and steel sheets.

THE BEAUHARNOIS HYDRO-ELECTRIC POWER SCHEME

(*For description see page* 205.)

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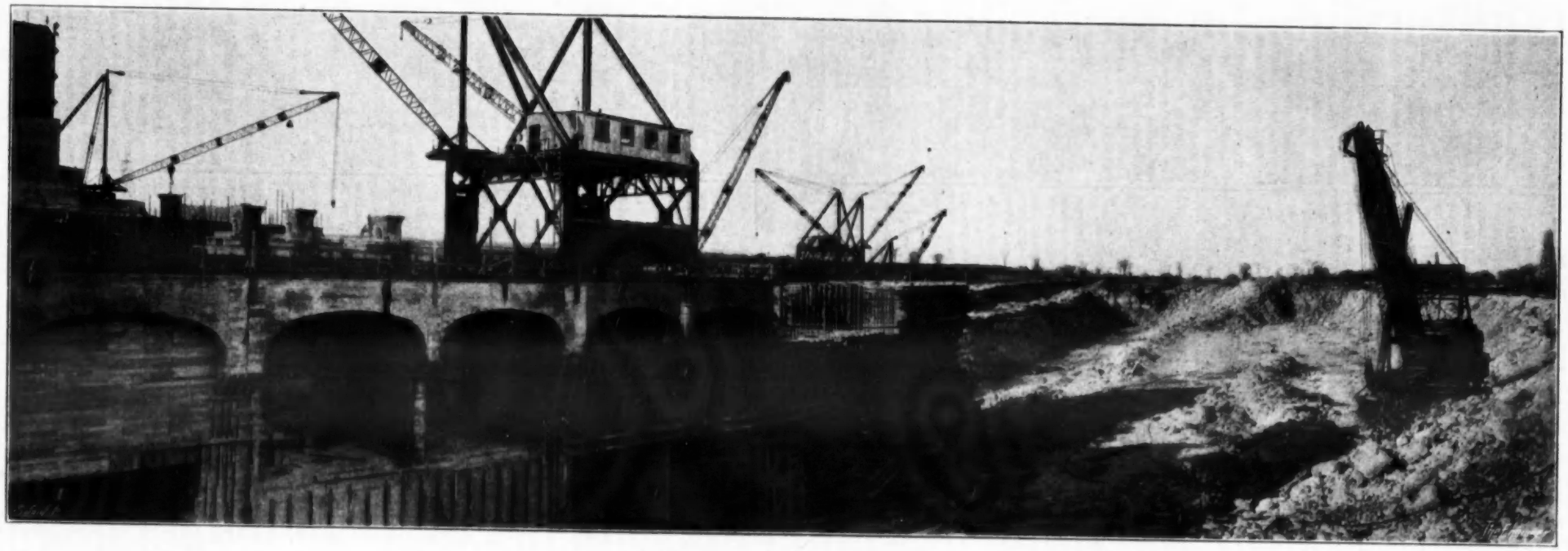

POWER HOUSE UNDER CONSTRUCTION

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THE ENGINEER.

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FEBRUARY 20, 1931.

Sir Charles Parsons.

To Great Britain belongs the credit for the origination of nearly all the fundamental inventions for the production and industrial utilisation of heat energy. The history goes back to the end of the seventeenth century, and another chapter has been closed by the death of Sir Charles Parsons. Whatever Captain Savery may have drawn from the scientific investigations of others, the fact cannot be challenged that he first applied steam to a useful purpose on an important scale. But far more notable than he was his successor, Thomas Newcomen, of Dartmouth, the real father of the steam engine. His invention, improved in some respects, but fundamentally unchanged, held the field for the greater part of the eighteenth century. Then, in 1869, James Watt's famous patent embodying the independent condenser, was granted, and the reciprocating engine, vastly improved in efficiency, took on a new lease of life. Whilst Watt was extending the use of large very low-pressure engines, Trevithick developed the high-pressure, high-speed engine, and so paved the way for the coming of the locomotive. That was at the very beginning of the nineteenth century, throughout which the Watt and the Trevithick engines were the principal sources of industrial power. But that wonderful period was not to close without another British invention in the domain of steam engineering of equal merit with its predecessors. In 1884 Charles Parsons patented the steam turbine, and opened an era of progress which owes everything to that invention, for without it electricity supply on a vast scale would have been limited to countries possessing water powers, and high speeds at sea would have been impossible. In passing, it is of interest to observe the persistence of a long interval between these great inventions. First, the Newcomen engine almost at the beginning of the eighteenth century ; then the Watt rotatory engine and the Trevithick high-pressure engine at the end of that century ; and, finally, the Parsons turbine in the penultimate decade of the nineteenth century. Must we wait another fifty years or so for the next great achievement, and will it also fall to the credit of this little island ?

Charles Parsons' name will be blazoned on the roll of fame beside those of Newcomen, Watt, and Trevithick. Whilst it is true that the conception of the turbine was ancient, and that many men had secured patents for designs, and that one at least—Richard Boyman Boyman—had some scientific understanding of the principle involved, it made little or no practical progress until Parsons, when quite a young man, introduced stage expansion with axial flow, and began the series of experiments which led ultimately to success. The introduction of a revolutionary invention calls for qualities of a high order. Men are not easily diverted from the known and familiar, and the inventor must be inspired by a firm conviction that he is right, and must have the ability to persuade others to put their trust in him. He must also possess powers of initiative, with infinite resource and courage, and must not be turned from his purpose or be disheartened by initial failures and disappointments. In these respects Parsons resembled the famous predecessors we have named. He faced boldly a problem by which most engineers of his day would have been baulked. Calculation showed that a blade speed of 220ft. per second would be necessary in his design. Nowadays, engineers are not deterred by that, and even by much higher speeds of rotation, but they were almost unthought of in mechanical engineering fifty years ago, and it required great courage even to attempt them. Parsons' first experiments would have discouraged most inventors. The turbine worked, it is true, but its steam consumption was between five and six times that of the best reciprocating engines of the time. But Parsons was looking for something more than an engine alone. At that period he was not thinking of the turbine for marine propulsion ; he was not thinking of it as a unit which could be applied, like a reciprocating engine, to various purposes. The object which he had before him was the production of a steam dynamo, and there is no question that he thought of the turbine and the generator as a single-power unit. In that he displayed vision, which is at the root of all epoch-making inventions. He foresaw, possibly dimly, the future that lay before electricity supply, and he knew that it was then constrained, and must ever be constrained, by the limitations of the reciprocating engine. What was wanted was an engine, naturally balanced, which could run at the speed of rotation necessary in a dynamo of small dimensions. It was this combination of the turbine and the dynamo that led to success, for even though the new motor was less efficient than the old, its particular qualities for dynamo driving compensated for the loss. It was not till many years after it had established itself for electricity generation that Parsons—almost reluctantly and at first without conviction—began to think of it as a marine engine, and he began with the little "Turbinia," that fascinating series of trials which eventuated in the "Vespasian" and the adoption of speed reduction gearing at sea. The turbine now has entered upon the whole field occupied by the reciprocating engine, and is the direct parent of a large family of high-speed devices designed especially to take advantage of the facilities which it offers. It is when we contemplate, in the first place, the incalculable effect which the turbine has had upon the supply of amenities to mankind through the agency of the high-speed dynamo ; in the second place, the importance of the position which it has acquired at sea ; and, finally, the collateral effects in the development of high-speed engineering—that we feel to the full how worthy the name of Sir Charles Parsons is to be honoured beside that of those other great men who have made English engineering famous from pole to pole.

Amongst the characteristics which Sir Charles shared with other great inventors was that of his youthfulness at the time his invention first took form. He was about thirty years of age, and it is a noteworthy fact that Watt and Trevithick—besides many other notable pioneers—were well under middle age, little more than youths, in fact, when their work was initiated. Invention a hundred and fifty years ago, and even fifty years ago, was different from what it is to-day, when it is often put into the hands of "research" departments. But it is probable that in the beginning great inventions are the result of inspiration, and it is as likely that the next great discovery will be given to the world by some young man, fired with an idea as that it will be won by patient endeavour in a crowded laboratory. Method has many merits, and achieves notable ends, but of its very nature

it lacks the divine afflatus which leads to spontaneous inventions with results to the world which, as in the case of the Parsons turbine, the inventor himself can only dimly foresee.

Industrial Economy.

IN our issue of February 13th we gave lengthy abstracts from a speech which Sir Allan Smith addressed to trades unions at a special conference convened by the Engineering and Allied Employers' National Federation. Below we reprint long passages from a memorandum, entitled "The Industrial Situation," recently circulated by the National Confederation of Employers' Organisations. In many respects these two statements are complementary to each other, but in none more than the stress which both lay upon the effect of excessive production costs in British industries. Those excessive costs are due, in part, to wages, which are too high per unit of product, and in part to a weight of taxes and municipal rates which are by far the highest in the world. Sir Allan Smith dealt with the wages problem as it affects the engineering industry; the National Confederation discusses wages upon a larger basis, but the principal burden of its report is the crying necessity for a reduction of the national and municipal burdens by which the exporting industries of the country are hampered. We may also recall that towards the end of last year the Engineering and Allied Employers' National Federation issued a very remarkable pamphlet, entitled "Realities and Problems," in which the same questions were discussed and the same answers reached.

There are people who have the hardihood to assert that if only the industrialists of this country would get together, they could prepare such a trenchant indictment of the present industrial policy of Great Britain that the Government would be compelled, from sheer conviction, to make essential changes. In the three memoranda to which we have referred we have that indictment, but we must unwillingly admit that, for ourselves, we are extremely doubtful that the Government will take the slightest notice of it. To our mind, one of the deplorable features of the whole industrial situation is that none of the necessary steps can be taken without the consent and co-operation of Parliament. There was a time, not so many years past, when industrialists managed their own affairs, and when the economics of the country's trade were permitted to be subject to the pressure of recognised facts. Successive Governments have not only robbed the industrialist of the right to manage his own affairs, but, still worse, they have endeavoured to defy the laws of trade. We perceive the consequence in the present state of this country. Instead of allowing the standard of living to be settled by the condition of competitive industry, an artificial standard has been set up. That standard can only be maintained by crippling impositions upon industry itself. At the same time, the organisation required for the management of these artificial conditions has resulted in a great increase of bureaucracy, and the rapid growth of taxation. Let us take a few figures from the *Industrial Situation*. Two of our keenest competitors are Germany and Belgium. The national taxation of the first is 50 per cent. of that of Great Britain and of the second only 38 per cent. Upon social services in 1926 Germany expended less than half what we do and has recently taken steps to reduce her commitments. In Belgium the amount was about one-fourteenth of our expenditure. At the same time that these heavy imposts are falling upon industry, we have to pay in real wages—money wages expressed in terms of food purchasing power—one hundred units against Germany's seventy-four and Belgium's fifty. We can imagine a sound argument in support of this high taxation, high expenditure on social service, and high standard of wages. It might be said that the taxes were being used for the development and insurance of the Empire; that the social services were ensuring to Great Britain a population of improved physique, capable of more useful exertion than before; it might be said in defence of high wages that the output was in proportion to them, and that the cost per piece was low. All this might be said; but it would not represent the facts. The moneys derived from high taxation are not being spent upon the consolidation of the Empire, nor upon the Navy for the insurance of its integrity; they are being used for altruistic schemes which the nation cannot afford. The social services may contribute to improved physique, but at the same time they subsidise indolence instead of encouraging greater efforts and greater personal initiative and courage; the highest wages are paid to sheltered industries which have not to meet foreign competition, and in too few cases are high wage rates in manufacture counterbalanced by increased output. Not one of the things which, perhaps, the visionaries foresaw has happened. On the contrary, the attempt to override the natural forces which control industrial affairs has resulted in bringing the country to the edge of disaster. It may safely be said that no other nation in Europe could have stood what Great Britain has stood and survived so long. But there must be an end to it, and even the socialistic Chancellor of the Exchequer has been compelled to admit that the national position is grave.

Mr. Snowden himself would appear to have come at length to recognise that the time has come when an end must be put to lavish expenditure upon social services. There is no longer the money to meet it. Painful and disagreeable as it may be, it is better that the nation should suffer some hardship in order to recover a position in which it can compete successfully with other nations than that it should continue to exist in a fool's paradise with the shadow of doom hanging over it. It is absolutely essential that we should get back, and get back quickly, to sound industrial economics. We have toyed too long with the sentimental idea of a "land for heroes to live in." Industry and commerce care nothing for "heroes." They are not feathers to be deflected from their ordinary course by the aspirations of reformers. As a nation we are dependent upon foreign trade which supplies us with 60 per cent. of the food upon which we live. If we fail to get that foreign trade, a time must come when we can no longer obtain the food. That is the bald fact that has to be faced. In order to secure the trade, we must be able to compete at least on equal terms with other nations. That we cannot do whilst our production costs are too high, and the production costs cannot fall as long as a large percentage of them is represented by real wages in excess of those of other industrial nations, and, above all, by a burden of taxes and municipal rates—largely expended upon social services—that is nearly double that of any other European country.

The Industrial Situation.

THE National Confederation of Employers' Organisations has just issued a remarkable report upon the industrial situation. From it the following passages are abstracted.

Disparities Handicapping British Trade.

The export trade of this country is the very essence of its life, and it is the serious decline in that export trade—a decline inevitably reacting more and more upon the whole trade of the country—which is at the very foundation of this country's industrial depression. While the population of this country has between 1913 and 1930 increased by more than three millions—an increase of 8 per cent.—the volume of the exports of British produce and manufactures shows within the same period a decrease of fully 30 per cent. The significant fact, however, is that even by 1929—before the world depression began—our exports had fallen by nearly 20 per cent., as against 1913, in spite of the fact that during that same period the trade of the world as a whole had increased by 25 per cent.

The major reason for that loss of export trade is that British costs of production—and therefore our selling prices—are too high as compared with those of our competitors. When we examine the disparities in the high standards of living and public expenditure which exist in this country as compared with those which exist in competing countries, the reason for the handicap in our production costs becomes manifest.

Disparities between ourselves and our competitors permeate the whole of our industrial and social life, and this may be illustrated by the following comparisons:—

(*a*) *National Taxation.*—The disparity in national taxation per head of the population is approximately as follows (*Hansard*, November 4th, 1930):—

Great Britain	100
France	64
Germany	50
Belgium	38
Italy	30

(*b*) *Wage Levels.*—The disparity in the level of real wages, *i.e.*, money wages expressed in terms of food purchasing power, is approximately as follows (*Ministry of Labour Gazette*, 1929–30):—

Great Britain	100
Germany	74
France	59
Belgium	50
Italy	45

(*c*) *Social Services.*—The disparity in the cost per head of the population for the five social services of unemployment, health, workmen's compensation, old age pensions, and poor law relief was in 1924 approximately as follows (Report of Royal Commission on Health Insurance, 1926):—

Great Britain	100
Germany	48
France	17
Belgium	7
Italy	4

Taking account of the developments in the various countries since 1924, including the addition of widows' and orphans' pensions in Great Britain, the above figures still represent the approximate comparative position to-day, except in the case of Germany, which within recent years added considerably to its social service expenditure, but has within recent months taken steps to restrict it.

Any comparison between our standards and those in the U.S.A. must take account of the fact that U.S.A., with its great natural resources, is self-supporting and does not depend upon its export trade for its existence. Its real wage level stands at 188, but its taxation level is little more than a third of ours and, as it has not adopted the policy of providing these social services for its workers other than workmen's compensation, its expenditure per head on these services is negligible.

It is idle to think that a country like ours, which depends upon its export trade for its existence, can, in the industrial world of to-day, continue to set up and maintain standards of living and public expenditure regardless of those of its competitors without paying the price of unemployment.

We feel it our duty to dispel the impression that the removal of these disparities and the recovery of British industry will come from the activities of the International Labour Organisation at Geneva.

The purpose of that Organisation, as set up by the Treaty of Peace, was to secure common minimum standards of labour throughout the world and so remove the unfair conditions which advanced countries have to face in international trade competition. It is possible that that Organisation may in the future being to realise the true purpose for which it was set up, but there is as yet little sign. On the contrary, the experience of the past ten years has merely revealed the reluctance of our competitors to face the adoption and the observance of conditions which would impede their competitive power by bringing their standards nearer to our own.

We say without hesitation that any suggestion that the remedy for our present industrial situation can be expected from Geneva is merely another method of avoiding the frank recognition that the time has come when this country must itself solve its own problems.

State Obstacles to Recovery.

In dealing with the industrial factors and putting forward our proposals on them, we do not claim that they constitute the sole remedies of which this country can or should avail itself, nor do we overlook the necessity of the nation pursuing all remedies capable of assisting in the restoration of its industrial prosperity.

At the same time, it would on our part be the greatest disservice to the nation if we flinched from making it clear that there is no remedy or combination of remedies which will enable this country to regain its industrial and thereby its national prosperity so long as it insists upon maintaining at all costs its present standards of living and public expenditure.

It is a common practice to speak of "rationalisation" as a way out of all our difficulties. We recognise the place which the maintenance and increase of efficiency, the elimination of waste and the keeping of plant and processes up to date—now known as "rationalisation"—hold in any process of recovery. It is realised that in the present days of keen competition and world-wide concentration on improved methods, there is a greater call than ever for rationalisation in every industry, but to look to rationalisation as a remedy which can of itself enable us to overcome the disparity between our costs and those of our competitors is to ignore the essential fact that rationalisation is as much open to our competitors as it is to us, and to avoid facing the fundamental disability which lies at the root of our industrial depression and our whole unemployment problem.

That fundamental disability is that, while the standards of our competitors are at a level which leaves little room for reduction, this country, by setting up higher standards and insisting on their maintenance, has introduced into its costs of production an element of rigidity which constitutes the main obstacle to bringing these costs down to a point where we can compete successfully with the goods of other countries in the world's markets.

It is commonly supposed that the remedy for rigidity in costs or production is a matter for industry itself, but a retrospect of the past ten years will show that, while there are still certain elements in the costs of production which are within the control of industry, the inherent cause of the rigidity is the action of the State.

In demonstrating how State action has brought rigidity into our costs of production we do so under the following heads:—

(1) Maladjustment of wage levels;
(2) Excessive public expenditure;
(3) Legislative restrictions on industry;

and we put forward, under each head, our proposals as to how the State can take steps to remove the

rigidity which it has itself imposed and thereby remove the primary obstacles which to-day stand in the way of our industrial recovery.

(1) *Maladjustment of Wage Levels.*—Taking British industry as a whole, wages are the largest element in the cost of production.

In spite of the more or less continuous fall in world prices since 1922—the *Economist* wholesale price index number is in fact now below its pre-war level—the average wage level of this country has remained stationary. Before the war it was our export industries, sensitive to world conditions, which set the general standard of our wage levels, but since the war that standard has been set, not by our export industries, but by our non-export industries. We have therefore lost that vital safeguard which previously linked the general standard of our wage levels to the prices which our goods could command in the world's markets.

It might at first sight be imagined that wages are controlled solely by the employers and workers in the various industries themselves, and that the State has therefore had no responsibility for the post-war maladjustment of wage levels in this country. We would, however, point out that since the war the State (*a*) by fixing high rates of unemployment benefit and constantly relaxing the conditions for the payment of it; (*b*) by paying grants to local authorities for distribution in wage rates higher than our export industries can afford; and (*c*) by the extension of statutory wage-fixing machinery has not only, in large measure, determined the general standard of wage levels, but has also done so in such a way as to make it difficult, if not impossible, for employers and workers to rectify the maladjustments which have grown from that State action.

(*a*) *Unemployment Benefit and Conditions.*—The following table contrasts the benefits in 1921 with present-day benefits, and also shows what these present-day benefits would have been if the 1921 benefits—instead of being increased—had been reduced in proportion to the fall in the cost of living.

	Unemployment benefit.	
	Single man.	Man with wife and 3 children.
(1) Actual benefit:	s. d.	s. d.
1921 (Dependants' Benefit Act)	15 0	23 0
1931 (present-day rates)	17 0	32 0
(2) What present-day benefits would be if they had followed the fall in cost of living since 1921	11 4	17 4
(3) Percentage reduction on present-day benefits which would bring them into line with 1921 benefits on a cost-of-living basis	33⅓%	46%

It will be seen from the above table that if the fall in the cost of living since 1921 had been given effect to, the present-day benefits would, in the case of a single man, be 33⅓ per cent. less, and in the case of a married man with a wife and three of a family 46 per cent. less than they actually are to-day.

Having regard to these high rates of benefit and the laxity of the qualifying conditions, it is only natural that trade unions, anxious to maintain their wage levels and knowing that their unemployed members can count on unemployment benefit more or less permanently at these high rates, are disinclined in wages negotiations to take the same account of the necessity of adjusting wages to levels at which industries can absorb their unemployed, as they had to do when there was no general State benefit and when such limited benefit as was provided to their members had to be provided by the trade unions themselves out of their own union funds.

We have throughout supported a system of unemployment insurance as part of the industrial organisation of the country, provided it adhered to the fundamental principles and safeguards laid down in the original Acts of 1911 and 1920. But the progressive demoralisation of the system has now for many years been sapping the independence and enterprise of the people, and by preventing trade depression from acting as a corrective factor in the adjustment of wage levels, has, in fact, been spreading the very disease which the system was intended to relieve. The system, which even by April of last year was costing £53 millions a year, is now costing £110 millions a year.

In view of the necessity for immediate remedy pending the carrying through of that review, we recommend, as emergency measures:—

(A) That the existing rates of unemployment benefit should be immediately reduced by 33⅓ per cent.

(B) That that reduced benefit should be confined to claimants who have at least six contributions to their credit for every benefit they draw.

(C) That those at present drawing unemployment benefit, who cannot satisfy the above test, should be dealt with through a special fund provided by the Government and administered locally on a means test basis which would have regard to the circumstances of the individual case.

(*b*) *Local Authorities' Wage Levels.*—It is common knowledge that a workman in this country to-day, in an employment which does not have to face world competition, enjoys a very much higher increase over his pre-war wage level than a corresponding workman in an industry exposed to foreign competition. That maladjustment in wage levels is nowhere more evident than in the case of the municipal services and contracts which they control.

In so far as local authorities provide these high wage levels from local rates, they are directly decreasing the competitive power of the export industries in their localities. In so far as they are provided from State grants, they constitute an endorsement by the State of an order of things which is directly detrimental to the welfare of an exporting country such as ours.

It is manifestly unfair that public funds, to which the exporting industries have to contribute their share, should be used by local authorities for the maintenance of wage levels higher than the exporting industries themselves can afford for the same class of work. When it comes to public funds being spent on relief works, the anomaly of these high wage levels, increasing the very unemployment which they are intended to alleviate, is more than ever manifest.

It is clear that so long as this state of affairs continues with the direct and indirect sanction of the State it must inevitably increase the difficulties of the employers and workers in the various industries in carrying out an adequate adjustment of their own wage levels. We therefore recommend:—

(D) That the Government should immediately review its wage levels in relation to those of the exporting industries and make an appeal to all local authorities to adopt the same policy.

(E) That the Government should also make it known to all local authorities that in future all public grants will carry with them the condition that they are not to be used in paying wage rates higher than those paid to a workman of corresponding skill in the exporting industries in that locality.

(*c*) *Statutory Wage-fixing Machinery.*—The direct intervention of the State in wages questions has been greatly developed during the past ten years, and, as illustrating how the operation of statutory wage-fixing machinery has contributed to the present maladjustment of wage levels, we need only refer to the operation of the Trade Boards system which was set up in 1909 to prevent "sweated" wages, and which, under the Act of 1918, now governs the wages of more than a million workers. In 1922 the Government Committee of Inquiry (Cave Committee, Cmd. 1645) pointed out that these Boards were fixing the general minimum time rates for unskilled and semi-skilled adult male workers at rates varying from 44s. to 66s. a week and time rates for skilled workers or foremen as high as 93s. and 94s. and even 96s. a week. That position is substantially the same to-day.

The Committee therefore unanimously recommended that the power of Trade Boards to fix wages compulsorily and enforce them by criminal proceedings should in future be limited to an "anti-sweating" rate, but effect has never been given to that unanimous recommendation.

We therefore recommend:—

(F) That immediate legislative effect should be given to the recommendations of the Cave Report of 1922 so as to confine the compulsory wage-fixing powers of Trade Boards to an "anti-sweating" rate.

Taxation, instead of taking up one-eighth, now absorbs almost a quarter of the total income of the whole nation. No other country is subjected to taxation of this magnitude and it is quite impossible to dissociate that disparity in taxation from our unemployment problem of the past ten years. The strength of British industry in the past has, in large measure, come from its ability to build up reserves for expansion and development, and the State, in taking from industry huge sums in taxation, is depriving it of the very means which would otherwise be available to facilitate that expansion and development which forms so large a part of the problem of "rationalisation."

We feel quite certain that a Committee on National Economy applying itself vigorously to the reduction of public expenditure would find ample scope for very substantial reductions. We therefore recommend:—

(G) That there be immediately set up a Committee on National Economy to report its conclusions within a few months and that all local authorities be urged by the Government to adopt a similar procedure.

(H) That, pending the decisions of the Committee on National Economy, no further civil servants should be recruited and that local authorities should also be urged by the Government to give effect to a similar policy.

By the social services we mean the various services relating to unemployment, health, widows' and orphans' and old age pensions, education, housing, poor law, &c., described in detail in the Government's Annual Return of Social Service Expenditure. That Return for the year ending April, 1929, which is the latest available, shows, as against £63 millions in 1911, an expenditure of £400 millions, a sum which, though not paid entirely by the Exchequer, is twice as great as our total pre-war national Budget of £200 millions: almost half as great as our last year's national Budget of £829 millions; and equal to a quarter of the whole nation's annual wages bill of £1600 millions. Since then the cost of unemployment insurance alone has increased by £50 millions a year.

We are convinced that this colossal expenditure on social services is far greater than this country can afford; that the financial burdens it imposes on industry are, in no small measure, accountable for our industrial depression, and that this country, in concentrating on insuring its people against all the risks of life, has in large measure deprived them of employment which is the greatest security of all.

The first step to secure an effective review and co-ordination of these services is to lay down a total sum within which they shall operate, and to fix that sum at a figure very considerably less than what was spent on them in 1929. We therefore recommend:

(I) That the Committee on National Economy, as one of its first duties, should fix a maximum inclusive sum considerably less than the £400 millions spent in 1929 out of which the whole cost of the social services must in future be met.

We further recommend:—

(J) That, as soon as the Committee on National Economy has fixed the maximum inclusive sum for social services as a whole, immediate steps should be taken to allot to each service its appropriate share of that expenditure and its appropriate sphere in the national plan; and to secure all reasonable and effective co-ordination in their administration.

(3) *Legislative Restrictions on Industry.*—Hand in hand with State activities resulting in the maladjustment of wage levels and the imposition of increased taxation, there has also been since the war a correspondingly increased tendency on the part of the State to impose restrictive burdens upon the conduct of industry which have added still further to our handicaps with our competitors.

The legislative programmes of successive Governments, in concentrating more and more on industrial issues, have, with the notable exception of the Derating Act, been directed, not to the increasing of our competitive power by diminishing our burdens and restrictions, but to the increasing of these burdens and restrictions as ideals in themselves without regard to the ability to British industry to sustain them.

When, in emphasising the unfairness of these new handicaps, we have pointed out that British working conditions were already superior to those of any other country, we have been told that it is the duty of British industry to act as the pioneer and heighten its standards no matter what other countries may do. For example, while our factory conditions are already second to none in the world, we have now for many years lived under the shadow of a new Factories Bill which would place further restrictions and on-cost charges on British industry.

Similarly, while our working hours are already shorter than those of any of our competitors, we have been living under the constant menace of a Bill which would ratify the Washington Hours Convention and, on this vital factor in costs of production, place our industry in a strait jacket of regulations while our continental competitors would remain free to enjoy their present latitude; and while the U.S.A.—which we are so often advised to imitate—is precluded by its very constitution from passing any Act which would limit the hours of work of its adult workers.

The Hours Bill now before Parliament proposes to ratify the Washington Hours Convention which does not mean the same thing either to or for all countries, and would deny to this country many of the practices which our continental competitors claim to be in accordance with that Convention and which they would continue to follow even if their countries ratified it.

Apart from legislative proposals and direct legislation, there has been during the past ten years the constant activity of Government Departments in framing and issuing, under their powers of delegate legislation, Departmental Orders and Regulations imposing fresh restrictions on British industry.

Looking back on ten years of increasing industrial adversity, we say deliberately that a time has come when a halt must be called to this constant pursuit of new standards, as ideals in themselves, without reference to their effect on our industrial competitive power. We therefore recommend:—

(K) That, until the unemployment percentage has been reduced to 5 per cent., no legislation should be introduced or proceeded with which will in any way add to the burdens or restrictions on industry, and that all Government Departments should be informed that, until that time arrives, no further burdens or restrictions should be placed on British industry by way of delegated legislation.

We fully realise that our proposals on the industrial factors involve sacrifice. As we have already pointed out, we do not claim that these proposals constitute the sole remedies of which this country can or should avail itself, and we do not underrate the part which other factors—political, financial and economic—may also play in any true national effort towards recovery. But we are profoundly convinced that none of these other remedies, or any combination of them, can enable this country to regain its industrial prosperity

without facing the fundamental industrial issues which we have raised and the sacrifice which their solution entails.

We are equally convinced that if the people of this country are frankly confronted with the seriousness of the situation they will meet it with that same fortitude and resolution with which they have met and overcome the nation's emergencies in the past.

The first step, therefore, towards our national recovery is that public opinion should realise the gravity of the present situation, and it is upon the leaders of political opinion, to whom the nation looks for guidance, that there lies the primary responsibility of confronting the nation with the facts.

Engineering Institute of Canada—Annual Meeting.

THE forty-fifth annual general and general professional meeting of the Engineering Institute of Canada was held in Montreal on February 4th, 5th and 6th, with a large attendance of delegates from all parts of the Dominion and a number of prominent members of the engineering profession from the United States. Important Canadian engineering works were reviewed in a series of technical papers, and reports of the various departments of the Institute indicated that the activity in Canadian engineering work noted in previous years was continued during the past year. Conditions as regards employment have been favourable, and many important projects contemplated or in progress have been available for consideration at the meetings of the Institute and its branches.

Samuel G. Porter, of Calgary, Alberta, was elected president of the Institute for the ensuing year. H. B. Huckleston, of Vancouver, and Dr. O. O. Lefebvre, of Montreal, were elected vice-presidents.

Lock Gates.—One of the principal papers dealt with the construction of the steel lock gates on the new Welland Ship Canal. This subject was presented by E. S. Mattice, M.E.I.C., vice-president of the National Bridge Company of Canada, Ltd., and former manager and engineer for the Steel Gates Company. The fabrication and erection of these gates presented several shop and field problems, which were of great interest and some of which appeared to be entirely outside previous Canadian experience. In the original design of the gates, and in the original measures adopted by the contractors and sub-contractors to ensure a good and thoroughly efficient structure, some precautions to ensure accuracy and water-tightness were taken, which afterwards either proved, or appeared, to be unnecessary, while, on the other hand, certain refinements might have been made which would have in the end reduced the cost of work. Examples of the first condition were: The punching of all field holes $\frac{1}{16}$in. smaller than the diameter of the rivet was found to be quite unnecessary owing to the use of modern spacing tables and multiple punches. The construction of the 82ft. gate end posts in one length in the shop, in Mr. Mattice's opinion, did not seem to have been necessary, and certainly added very greatly to the difficulty and cost of the work.

As an example of the second condition, the frames may be cited. It was specified that they were to be fabricated by ordinary structural practice. However, the apparently unavoidable toeing in of the connection angles rendered the securing of a water-tight job very expensive. In Mr. Mattice's opinion, it would have been much better had the ends of the frames been milled to a true plane surface.

The particularly interesting points in connection with the contract were:—(1) The method adopted to secure a uniform length for all girders, and the accurate machining of their ends, at the same time locating the holes for attaching the diaphragms; (2) the shop fabrication and erection of the endposts; (3) the adjustment of the end bearing plates to a practically true line, and the measuring for and machining of the shims to attain that end; (4) the erection of the spare leaves vertically in lock No. 2, and then the procedure of placing them in a horizontal position, and floating them to the gate yard.

Canadian Oil.—The oil prospects of the eastern foothills area of the province of Alberta, between the Highwood and Bow rivers, were discussed by Dr. G. S. Hume, of the Geological Survey Branch of the Federal Department of Mines. The foothills, which are considered to be an overthrust mass, thrust eastward on to the relatively flat-lying sediments of the plains, mark underlying "low angle faults" at points like Turner Valley, Jumpingpound and Wildcat Hills, and it is considered probable that another similar formation may be found in the district of the Highwood structure and its extensions to the north-west through Waite Valley, Fisher Creek and the Two Pine area. The whole foothills belt is considered to be structurally similar to the foothills of the Polish Carpathians, where large oilfields have been developed.

Train Ferries.—Another interesting paper, presented by D. B. Armstrong, A.M.E.I.C., and W. Chase Thomson, M.E.I.C., erection engineer and designer respectively of the Dominion Bridge Company, Ltd., of Montreal, dealt with the "Train-ferry Landings at Port Mulgrave and Point Tupper in the Province of Nova Scotia." The train-ferry between Port Mulgrave on the mainland of Nova Scotia and Point Tupper on Cape Breton Island has been maintained since 1901. The landings over which the trains pass from the ferry to the shore are structures which must accommodate the list of the boat, variation of draught, and a tidal range of about 7ft. After thirty years' service the demands of heavier and greatly increased traffic required the renewal of the original structures, and the old design was generally followed. Experience has enabled a number of improvements to be incorporated in the new landings, particularly in connection with the method of meeting the severe shocks when the steamer ferry is mooring, and with a view to obtaining increased stability and flexibility. Some definite measure of stability has been given to the longitudinal girders of the apron by means of double bearings at their hinged end. The outer girders were there converted into a box section, and double bearings on the shoe pin, about 20in. apart, were thus obtained. To serve a similar purpose at the hinged end of the inner girders, where a box section could not be used owing to the interference of the stringers of the intermediate leaf, double bearings on the pin were obtained by the use of substantial flanged castings, riveted to the heavily reinforced web of the girders. As a result of these improvements there is thus far no perceptible cant or twist in the main apron girders of the new structure.

The actual work of cutting away and removing the old structures and their replacement by the new was done in a period of four months. All major operations had to be carried out on Sundays, and in the case of some of them it was necessary to select Sundays on which the times and heights of the tide were suitable. The replacement of one apron and its intermediate span involved the handling of more than 450 tons of steel work, and with the renewal of 300ft. of track, had to be carried out in a period of 20 hours. The total weight of steel in the two landings is more than 1300 tons.

Block Signalling.—In a paper on "Automatic Block Signalling on the Canadian Pacific Railway," A. J. Kidd, assistant to the signal engineer, Eastern Lines, pointed out that the particular form of colour-light used by the C.P.R. is the so-called searchlight signal, which was first installed in 1927 on a section of double track between Streetsville Junction and Guelph Junction, in the Ontario district, a distance of 16·5 miles. This signal proved so satisfactory that its use has been rapidly extended, some 355 miles of this type of automatic signal being in service at the present time. No more signals of the semaphore type have been installed on the Eastern Lines since that time. In 1930 the searchlight signal was made the standard signal on both Eastern and Western lines.

Water Supply.—In the southern part of the province of Saskatchewan, the problem of obtaining sufficient water to meet the demands of growing cities and towns is important enough to justify prospecting for water. The results of recent investigations along this line were dealt with in a paper presented by W. A. Johnston, of the Geological Survey, Federal Department of Mines. He pointed out that the problem is largely a geological one and has been studied not only by officers of the Geological Survey of Canada, but also by a number of independent engineers, and water has been found in the vicinity of Regina and Moose Jaw. A large artesian well area has been discovered between Moose Jaw and the Southern Saskatchewan River, and the possibilities of this source of supply were briefly discussed.

Concrete.—A paper based on experience gained in the Chute-a-Caron power development on the Saguenay River, in the province of Quebec, was that of I. E. Burks, concrete technician of the Aluminum Company of America. The paper dealt with the placing of concrete on steep slopes without forms, and the author indicated that a recent advance in the construction of portions of structures which are steeply slopped consisted in the practice of placing the concrete without "top forms" and described the way in which this was done at Chute-a-Caron on curved surfaces as steep as 50 degrees.

For this purpose somewhat stiffer mixtures were used, and they required various tamping when being placed. Preliminary laboratory tests showed that with this character of mixture, properly rammed, the resulting strength was entirely satisfactory. The surface was shaped by the use of screens placed so that their bottom edges represented the finished surface of the concrete. Precautions necessary to attain satisfactory results were also described. It was pointed out that a considerable reduction in the construction cost of gravity type dams can be obtained in this manner.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of furnaces in operation at the end of January amounted to 83, a net increase of seven since the beginning of the month, nine furnaces having recommenced operations and two having been blown out. The production of pig iron amounted to 337,200 tons, compared with 349,800 tons in December, and 650,000 tons in January, 1930. The production includes 84,600 tons of hematite, 129,000 tons of basic, 93,700 tons of foundry, and 15,500 tons of forge pig iron. The January output of steel ingots and castings amounted to 402,200 tons, compared with 337,200 tons in December and 771,100 tons in January, 1930.

A New Insulation Works.

SOME years ago Ellison Insulations, Ltd., a subsidiary of George Ellison, Ltd., the switchgear manufacturers, of Perry Barr, Birmingham, began to manufacture laminated synthetic resinoid electrical insulating materials for use in the switchgear factory, but after a time other electrical firms in need of good insulating material became customers of the firm, which six months ago built a new factory to meet the rapidly growing demand. The new building, which is in close proximity to the switchgear works, has been designed on well-thought-out lines and is equipped with modern presses, machine tools—see Figs. 3 and 4—and other plant necessary for this particular class of work. The machinery and plant were designed and to some extent manufactured in the Ellison switchgear works, and the large capital outlay represented shows foresight and great confidence in the product. When it was decided to look into the question of manufacturing insulation a chemist was appointed and a laboratory established to investigate the whole subject. Experiments lasting several years were made in the methods of manufacture before the business was run on commercial lines, with the result that the firm is now in a position to offer perfectly satisfactory products to its clients.

Resinoids in the form of lumps, solutions, varnishes and cements, moulding compositions in the form of powder,

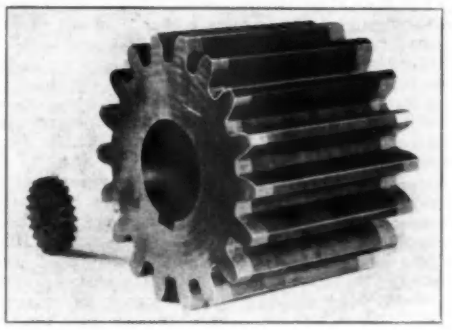


FIG. 1—TUFNOL PINIONS

specially selected paper, canvas and asbestos constitute the raw materials of the trade. Synthetic mouldings made from the powder are sold as a finished article or component part, whilst the standard Tufnol laminated products, which are made from a paper base, are sold as sheets, tubes, rods, &c., ready for machining to the desired shape. Owing to the reinforcement produced by building up from layers of treated paper, canvas, cambric or asbestos the laminated products have great mechanical strength, and may be used in the manufacture of pinions—see Fig. 1—and other mechanical parts. Blanks for the production of silent pinions and gears are usually cut from heavy sheet fabric Tufnol up to 3in. thick, but may be moulded as cylinders or be moulded into steel bushes or spiders. Another use for fabric Tufnol is illustrated in Fig. 2, which shows moulded wedges or keys applied to a steel rail in order to insulate the rail from the steel sleeper and earth for track circuiting and signalling purposes. The rail rests on a thin Tufnol pad, whilst the keys are driven in at the sides of the rail by means of a hammer in the usual way. These laminated

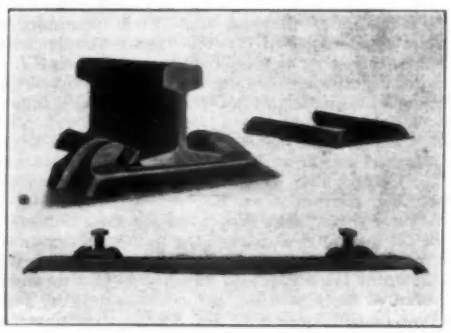


FIG. 2—TUFNOL RAIL WEDGES

materials, which are more or less new to all save those connected with the electrical industry, afford a means of avoiding corrosion troubles in several trades. Fabric gears are unaffected by water, oil, and most chemical solutions, and their wearing properties are said to be superior to those of the steel with which they engage. As regards electrical properties, the Grade 1 Tufnol material, which is the main product of the firm, is said to be much superior to the material dealt with in the B.E.S.A. Specification No. 316 on "Laminated Synthetic Resin Paper Boards for Electrical Purposes." Tufnol is much less absorbent and more tough, is better finished and it lends itself more readily to machining. The tubes and rods—see Fig. 5—are baked in steam-heated moulds in heavy hydraulic presses and strong screw threads can be cut on them and all kinds of articles can be made from these tubes and rods on a capstan lathe. Otherwise the mechanical and electrical properties are similar to those of the Grade II. material dealt with in the B.E.S.A. Specification.

As we have said, standard sheet Tufnol is made from a paper base and has a brown colour. For electrical insulation the paper is specially manufactured from wood or cotton to a specification similar to that which applies to paper for insulating cable. A variety of white and coloured papers is used for other purposes, as well as asbestos

A NEW INSULATION WORKS

ELLISON INSULATIONS, LTD., BIRMINGHAM, ENGINEERS

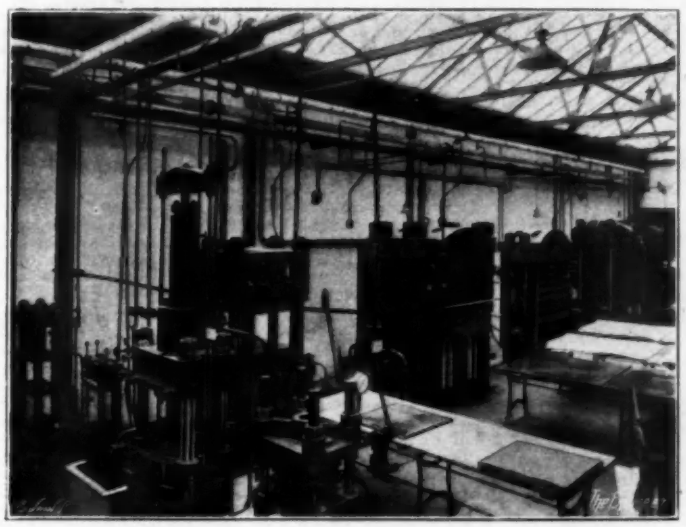


FIG. 3—PRESS ROOM

FIG. 4—MACHINE SHOP

papers for asbestos Tufnol, which is suitable for use at a temperature of 600 deg. Fah. In the manufacture of fabric Tufnol several grades of cloth ranging from fine cambric to heavy duck cloth, depending on the strength, machining properties and finish required, are used for reinforcement. The paper or fabric is impregnated with a spirit solution containing one of the phenol-aldehyde resinoids on machines which adjust the percentage of resinoid to paper or fabric and the web of material then passes through steam-heated drying and baking chambers. In the manufacture of sheet material the paper or fabric is cut into sheets which are built up to the thickness required, and the stack is then loaded between steam-heated platens on a large hydraulic press as shown in Fig. 3. The resinoid first softens and allows the air to be expelled and the mass to be solidly compressed, whilst further action of the heat causes the resinoid to assume a hard and insoluble state, and when the sheet is taken from the press and the ragged edges have been removed it is ready for the market.

Tubes are made by feeding the roll of treated paper to a machine having several electrically heated rollers, which wrap and compress the paper on to a steel mandrel, which, in the case of small tubes, determines the finished bore to within plus or minus one-thousandth of an inch. After the tube wall has been built up to the required thickness and the paper has been cut off, the covered mandrel is transferred to a heavy steel mould and pressed between the hot plates of a suitable press producing from 100 to 300 tons pressure, and as in the case of the laminated sheets, the material is baked. As they come from the press the tubes carry fins of excess resin and paper, which are removed by a saw, the tubes then being ground down to gauge and polished and finally the mandrel is removed. In this way all shapes of tube, solid bar, and rod are manufactured. Tubes with a square bore and round exterior for making carbon brush holders, tubes of round bore and a hexagon exterior for making nuts for use with Tufnol bolts and solid sections similar to rolled and extruded metal sections, as shown in Fig. 5, are examples of these products.

Moulded spools, bobbins, base plates, screwed caps, and rings and components with metal insertions are moulded on the various types of presses from the usual powder obtained from an outside source, one of the presses being capable of moulding articles up to 24in. square. When mechanical strength is required Tufnol is also moulded into finished and partly finished articles; the tensile strength of Tufnol being about 14,000 lb. per square inch against about 1500 lb. for the synthetic powder mouldings. The resinoid used for the powder mouldings is incorporated with various fillers according to the properties required in the finished product. When wood flour is used as a filler, moulded articles can be drilled, tapped, or machined, but these subsequent operations are generally avoided by moulding the article in the form in which it is required. It is possible, for example, to mould articles with quite good screw threads which will meet most ordinary requirements. While the moulding powders are produced in two standard colours, black and brown, it is possible by special treatment to obtain other colours. From an electrical point of view, moulding materials with wood flour fillers possess excellent qualities, such as good dielectric strength, and they are non-hygroscopic and are unaffected by immersion in water and most chemicals. When asbestos fibre is used as a filler, the resistance to heat can be considerably increased, but the mouldings are less easily machined.

Although Tufnol mouldings are much stronger than ordinary synthetic powder or composition mouldings when intricate shapes are required, they are more costly, and it is generally preferable to machine the parts from stock Tufnol sections. Examples of Tufnol mouldings and machined parts are shown in Fig. 6, whilst Fig. 7 shows a connector for high-tension work, comprising five copper conductors embedded in a solid block of Tufnol, each conductor being insulated from its neighbour. It is recommended that Tufnol be used at a working pressure of not more than 100 volts per one-thousandth of an inch thickness of sheet or wall thickness of tube, but the test pressure is, of course, about three times this voltage.

As Tufnol has some abrasive action whilst being cut, it is desirable to use the hardest steel tools for machining it, and whilst Tufnol can be cut with a small tooth joiner's saw, a hack-saw cuts it more quickly and the teeth remain sharp for a longer period. Hard circular saws with about fifteen teeth per inch, jig and band saws, are used for repetition work. The teeth should have a slight set and a peripheral speed of about 3700ft. per minute has been found to be suitable for circular saws. If the Tufnol is pressed on a piece of wood a fairly flat point, $\frac{1}{8}$in. twist drill running at 1200 revolutions per minute, gives a clean hole, but to prevent breaking away at the bottom of the hole, it is necessary to press the Tufnol down on the wood, and to press the drill lightly at the finish. Drilling jigs for fast drilling should have a hole in the lower plate as near the size of the drill as possible, and should be sharp cornered in order to support the Tufnol at the edge of the hole. If the back edge is well supported, a sharp-point drill may be used to drill more quickly. If the drill runs hot, the swarf will tend to clog the drill and make it still hotter, but this can be prevented by lifting the drill out of the hole after penetrating each $\frac{3}{32}$in. or $\frac{1}{8}$in.

In turning Tufnol it is customary to use high speeds and to make a light cut in order to avoid tearing the surface. The turning tool should have no rake, or, at any rate, a very small one. Whilst the best turning speed depends largely on the article to be produced, a peripheral speed of from 600 to 1000 revolutions per minute is a good general speed. Holes in Tufnol can be tapped by hand or by means of the usual machine-tapping arrangements, but when tapping blind holes in rods or tubes on the capstan lathe, care must be taken to see that the hole is not smaller than the top of the thread produced by the tap, and that it is deep enough to take swarf.

As regards screwing, although the grain of the tube and rod is in the worst possible direction, both external and internal threads stand up well, if they are not damaged while cutting. Hand dies may be used if they are adjustable for a first, second, and third cut, but it is necessary to exercise considerable care, for Tufnol is not malleable like metal, and any attempt to push the material aside instead of cutting it is liable to split off the thread. At a peripheral speed of 500 to 1000 revolutions per minute and with a three or five-point chaser, it is possible to obtain a good thread, and a drop of mineral oil on the tool helps to produce a good finish. Good external threads can be cut on a capstan lathe, but a self-opening die is necessary, or a still better plan is to use two die heads, one set for half cut and the other for the second or finishing cut. When a very strong thread is required, it can be moulded internally or externally on Tufnol tubes, but the cost of the special moulding tools must be taken into account.

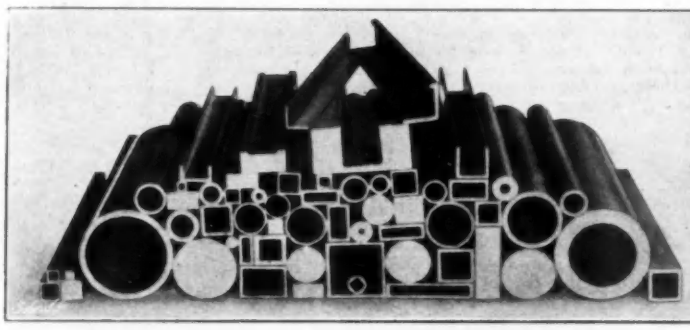


FIG. 5—TUFNOL RODS, TUBES AND SECTIONS

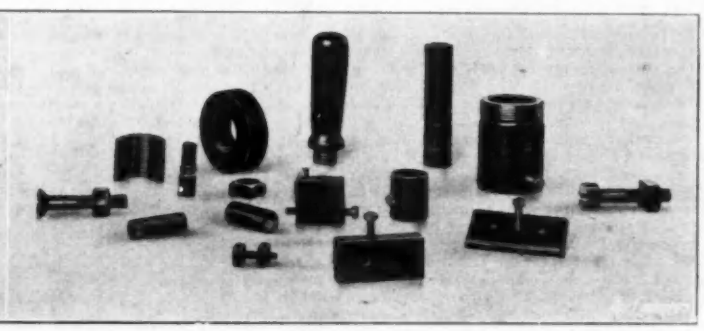


FIG. 6—TUFNOL MACHINED PARTS

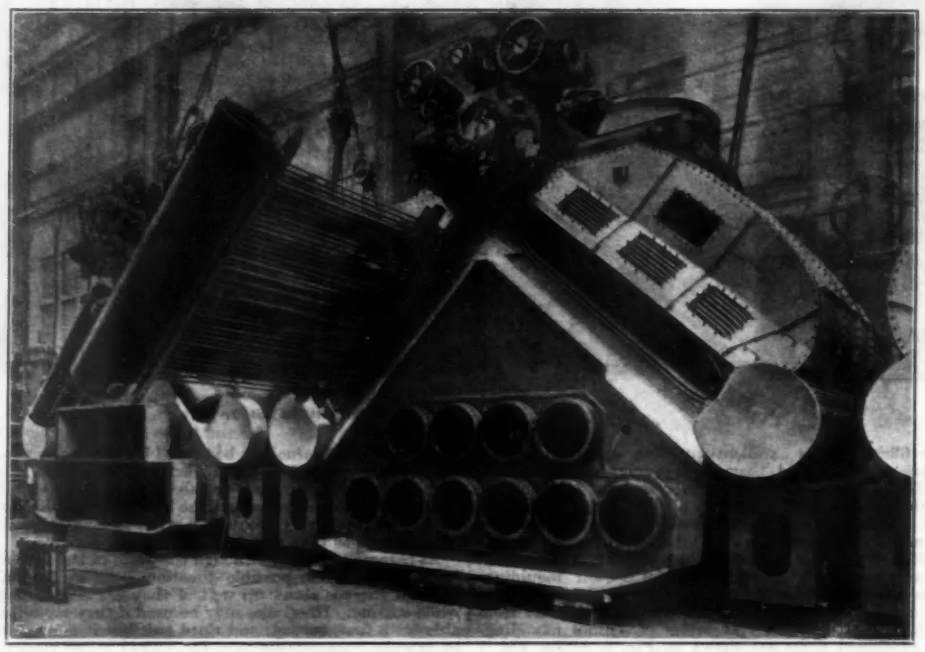
FIG. 7—TUFNOL H.T. CONNECTOR

When milling Tufnol fast speeds and light cuts give the best results on the usual type of milling machine and woodworking spindle moulder. A woodworking planer fitted with hard steel milling cutters also gives excellent and rapid results, but these machines must not be fitted with woodworking knife cutters, which are liable to break. When milling the teeth of fabric Tufnol gears which have no metal shrouds it is advisable to clamp a piece of hard wood or Tufnol on both sides in order to avoid the risk of pulling away the top lamination. Although Tufnol can be machined by planing and shaping tools, milling is much more satisfactory. As Tufnol is not malleable like metal, a punching or shearing die snaps it off instead of shearing or pushing it apart. If the male and female portions of the die fit well, and have sharp edges, the two faces of the Tufnol sheet will be correct to size, but the punched out edge will be more or less rough. Sheets up to $\frac{1}{16}$in. thickness may be punched cold, but in the case of sheets ranging from this thickness up to $\frac{1}{4}$in. thickness, it is sometimes necessary to warm the Tufnol and the dies. The sawn edges of Tufnol can be cleaned up smooth by scraping with the sharp back edge of a hack saw blade or similar piece of hard, sharp-edged steel, while the sheet is held firmly in a vice.

Tufnol is best ground on a sand-papering machine of the Linisher type, the grinding bands being open-grain garnet or flint, as a clogged band will burn the material. Grinding wheels may, however, be used with a liberal supply of clean water. The usual polishing spindle with dry cotton or linen mops lightly applied to the Tufnol will produce a high polish. Although not generally necessary, a wax and abrasive compound may be used on the first process mop. Suds, compound greases, soaps or salts should never be used for keeping cutting tools cool when working on Tufnol required for electrical purposes, as the smallest amount of soap, salt, acid, or alkali left on it will destroy the surface of Tufnol or any other insulation.

Water-tube and Scotch Boilers.

AN interesting symposium on the relative fields of development of the water-tube and the Scotch boiler in the merchant service took place at the Institute of Marine Engineers on Tuesday evening of last week, February 10th. The case for the water-tube boiler was ably presented in a contribution by Mr. Harold E. Yarrow, which, in the unavoidable absence of the author abroad, was presented by Mr. W. Nithadale, while Mr. Summers Hunter, jun., dealt with the present position of the Scotch boiler and indicated the recent developments and possible future prospects for that type of steam generating plant.



ADMIRALTY SUPERHEATER TYPE WATER-TUBE BOILER FOR DESTROYERS

Mr. Yarrow, in the opening section of his paper, referred to the half-century of development which had followed the first practical inception of the water-tube boiler between 1880 and 1890. Following the Admiralty Boiler Committee report of 1904, the water-tube boiler was, he said, rapidly adopted for all naval purposes, and it was now exclusively used in all the navies of the world. It was sometimes said, he continued, that in warship service a boiler was never required to develop maximum power over lengthy periods. This statement was, he remarked, perhaps true of peace time service, but war experience had showed conclusively that H.M. ships were able to maintain full power continuously when called upon. In any case, the full-power condition in a war vessel represented about three times the boiler rating, compared with the full-power condition in a merchant vessel. The water-tube boiler had operated at sea under most exacting conditions, and some of the more difficult cases, such as the shallow-draught steamers of the Yangtse Kiang River, had proved to be the most successful. Boilers of the water-tube type were giving excellent service in large passenger liners, cross-Channel steamers, cargo vessels, and yachts. The land development had been phenomenal, and power station engineers were now exploring in actual practice such fields as 3200 lb. per square inch pressure, 1,000,000 lb. per hour evaporation in a single unit, and 1000 deg. Fah. steam temperature. In some instances water-tube boilers were now running very successfully on 100 per cent. make-up feed water. Attention had recently been focussed on the high-pressure water-tube boiler by its adoption in leading merchant ships, such as the Canadian Pacific "Duchess" and "Empress" liners, the Canadian National "Prince" ship, the P. and O. liners, the Holland-America liner "Statendam," and the "Bremen" and "Europa," as well as the new Italian liners. The Canadian Pacific "Beaver" class cargo ships presented good examples of water-tube boiler practice with mechanical stokers, while the "G. Harrison Smith" was an instance of an oil tanker with a water-tube boiler and turbine propelling machinery. The results obtained with 400 lb. to 450 lb. working pressures had indicated that with still higher pressures improved consumption might be attained, and the feed water difficulty had been overcome, suitable alloy tubes having dissipated the condenser problem. Mr. Yarrow then went on to describe the careful manufacturing processes employed in modern boiler engineering, which he illustrated with lantern slides. The water-tube boiler was, he said, specially suited for mechanical firing, and it was capable of being forced to a great extent. In the latest cruisers the boilers were rated at 18 lb. evaporation per square foot of generating surface, corresponding to an output of over 200,000 lb. per hour per boiler, while destroyers had attained 24 lb. evaporation per square foot. For efficiency, mercantile boiler ratings were often between 5 lb. to 6 lb. per square foot of surface, and as the pressure parts of the boiler were similar for commercial and naval use, the large margin would be appreciated. New developments might be looked for in the direction of mechanical stokers, pulverised fuel and water walls, while such appliances as low water alarms and feed regulators greatly simplified stokehold duties. Upkeep costs were low, and in recent liner installations 87 and 88 per cent. gross overall efficiencies had been obtained.

In presenting his paper on the Scotch boiler, Mr. Summers Hunter, jun., gave a brief review of the development of the cylindrical boiler in merchant ships. He pointed out that the conditions in naval service with the ever-ready *personnel* were quite different from mercantile conditions, and requirements were therefore different, so that no direct comparison could be made. He took the opportunity of referring to the greater interest which had been taken by naval engineer officers in the work of the Institute of Marine Engineers since the war. It had been most welcome and beneficial to all concerned. An interesting part of the paper was that in which Mr. Hunter gave some instances of recently modernised cylindrical boiler installations in British-owned ships, which results were taken from several similar voyages made before and after conversion.

(1) In 1927 the Canadian Pacific liner "Empress of Australia" had a new Scotch boiler installation and propelling machinery fitted, with the result that she now does 19½ knots on 150 tons of fuel oil per day, or 0·70 lb. per S.H.P. for all purposes, and 0·65 lb. per S.H.P. for propulsion, as compared with 16½ knots on 205 tons per day. The new boilers supply steam at 220 lb. and 630 deg. Fah., so that with higher steam pressure and temperature further economy could be attained.

(2) By modernising the Scotch boiler plant and renewing the turbines and auxiliary machinery where necessary, several medium-sized passenger ships were now able to maintain their service with eight Scotch boilers in operation instead of ten, and the consumption of oil was reduced from 140 to 100 tons per day for all purposes.

(3) A 12,000-ton d.w. cargo vessel employed four Scotch boilers, 220 lb., burning 48 tons of coal per day to maintain a speed of 10 knots. Modification to three boilers had enabled the fourth to be laid off, and the original speed maintained on only 38 tons per day.

(4) An 8000-ton d.w. cargo liner, with 190 lb. triple-expansion engines, used to do 12·6 knots on 70 tons of coal, but the modernising of her steam plant had enabled her to do 12·9 knots on 61·7 tons of the same coal, as well as supply steam to additional machinery for refrigeration purposes.

(5) An 8400 ton d.w. cargo vessel, with 180 lb. triple-expansion engines, used to do 7¾ knots on 25½ tons of coal, but alterations to the boiler plant enabled her to do 9¾ knots on 26¾ tons with the same fuel.

(6) An 8200-ton d.w. cargo liner, with 180 lb. double-reduction geared turbines, by increasing the steam temperature from 520 deg. to 600 deg. Fah., had reduced the daily coal consumption by 6 per cent.

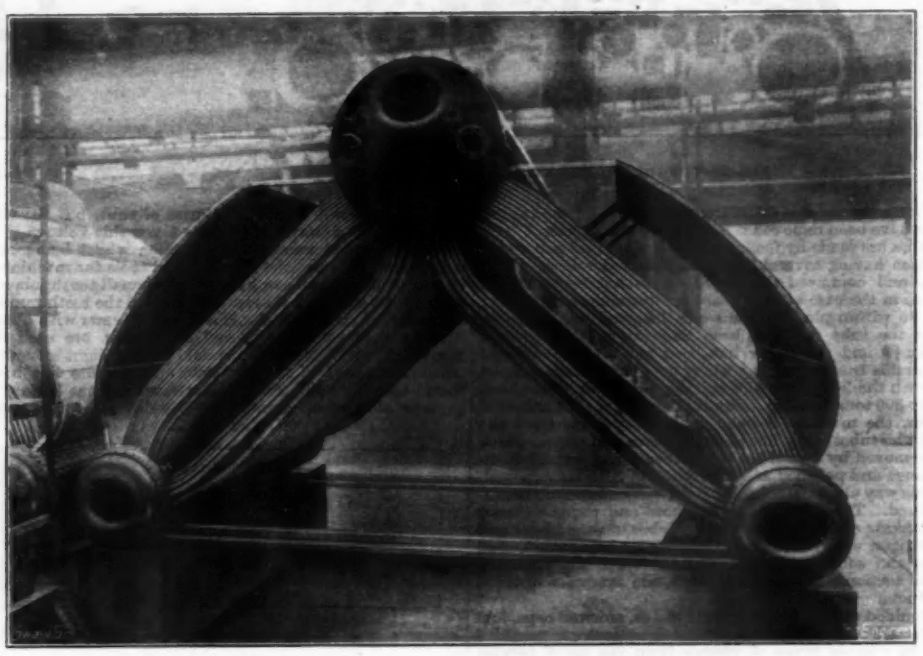
(7) A 16,000-ton d.w. cargo and passenger liner, with 190 lb. working pressure, used to do 13·6 knots on 151 tons of coal per day, but modernising the steam plant enabled her to do 13·5 knots on 117 tons per day, equal to a saving of 20 per cent.

The author then proceeded to discuss some modern adjuncts to Scotch boiler installations which had assisted in bringing about the economies above mentioned. These included, he said, air heating, forced or induced draught, superheating, higher pressures, and feed-water heating and filtering. Air up to 400 deg. Fah. could now quite well be obtained, but 200 deg. to 300 deg. Fah. was perhaps more usually employed.

Mr. Hunter then described the new combustion chamber superheater for Scotch boilers, which was fully dealt with in our issue of January 9th. With this type of superheater steam up to 700 deg. and 750 deg. Fah. was, he said, being obtained, and was available for turbines and also poppet valve reciprocating engine installations. Such a superheater had effected savings of 8 per cent. in fuel compared with saturated steam performance. In 1908 there were just over 160 ocean-going ships using superheated steam in Scotch boilers and now there were 4456 ships of 9,160,000 I.H.P., which figure covered also European-built ships with the exception of French-built vessels. Improvements had been made on feed heating up to 300 deg. Fah. and also in boiler insulation for which many materials were available. The highest pressure Scotch boilers in service in an ocean-going steamer were, as far as the author knew, those of the "City of Roubaix," propelled by geared steam turbines, using 300 lb. pressure steam at 600 deg. Fah., with modern feed heating and 380 deg. Fah. air. An efficiency of 85 per cent. when burning coal, equal to a consumption of 1·09 lb. per S.H.P. hour for all purposes, had been obtained. A chart was exhibited showing that the temperature of the gases at the funnel base had now been reduced to 310 deg. Fah., which was well below the previously accepted figures of 500 deg. to 600 deg. Fah. New materials for fire-bars and furnace fitting were now available.

The discussion was opened by Rear-Admiral W. M. Whayman, of Babcock and Wilcox, Ltd., who expressed his agreement with Mr. Yarrow's statement as to the advantages of the water-tube boiler. A distinct advantage was the simplicity of the superheater arrangement. There was an increasing demand for higher pressures, along with reduced weight and space, and although oil fuel might still be used for the larger passenger liners, there was great need to develop the water-tube boiler in association with mechanical means for burning coal. Mr. W. W. Marriner, of Yarrow and Co., Ltd., supported Admiral Whayman in his plea for further advances in pulverised fuel burning and mechanical stokers in association with water-tube boilers.

Engineer-Captain S. R. Dight, R.N., of the Admiralty Fuel Experimental Station at Haslar, bore personal tribute to the reliability of the water-tube boiler in naval service. He described by means of blackboard sketches the development of the small-tube, three-drum, water-tube boiler as used in the Royal Navy since 1876, giving the characteristic features of the original Rowan boiler and the succeeding Thornycroft, Normand, Reed, Blechynden and White-Forster types. He also gave a brief account of the Navy's experience with the Yarrow and Thornycroft type of boiler before, during, and since the war. Captain Dight described at some length the experiments made by the Admiralty to improve the degree of superheat in post-war boilers, which had resulted in placing withdrawable superheater tube nests between the generating



PRESSURE PARTS OF BOILER WITHOUT SUPERHEATERS

tubes. In the later designs the superheater nests were placed nearer to the furnace than usual. With such an arrangement it was found possible to obtain a considerable degree of superheat at low outputs, typical results being 200 deg. Fah. at full output and 120 deg. Fah. at three tenths output. The durability in actual service had attained a satisfactory standard. Several lantern slides of recent Admiralty superheater type boilers were shown, and, by the courtesy of the Engineer-in-Chief of the Admiralty, Engineer Vice-Admiral Sir R. W. Skelton, and of John Brown and Co., Ltd., of Clydebank, we are permitted to reproduce in the accompanying engravings two views of a recent boiler built for H.M. destroyers. In the lower view the pressure parts of the boiler, without the superheater elements, are shown, while in the upper view the superheaters are in position, one of them being half withdrawn. The boiler has a designed evaporation of 156,000 lb. per hour from and at 300 lb. per square inch, with 200 deg. of superheat. The generating surface is 8100 square feet and the superheating surface 1150 square feet. The slightly bent arrangement of the tubes at the ends which enables better landings to be obtained where the ends are expanded into the drums may be noted. Engineer-Captain Dight was followed by Engineer-Captain R. Beeman, R.N., who suggested that the so-called Scotch boiler really originated on the Thames. It was in 1854, he said, that John Penn installed a cylindrical boiler in the gunboat "Malacca," and in 1862 John Elder, on the Clyde, adopted a cylindrical boiler to overcome difficulties with higher pressures. As regards the pressure, we might, he said, discuss the relative merits of water-tube and cylindrical boilers, but future competition would compel engineers to adopt high-pressure water-tube boilers. Mr. Sterry B. Freeman, of Alfred Holt and Co., Ltd., spoke as a member of the Admiralty Committee on Boilers, referred to by Captain Dight and he congratulated the Admiralty on the results it had obtained. The whole question of the water-tube boiler was, in his opinion, bound up with the question of rating, and the merchant navy would unhesitatingly adopt the water-tube boiler if it could be forced to something like the degree that it was in the Royal Navy. Could not the output be raised? He was informed that very good results were being obtained with the Benson critical pressure boiler working at 3200 lb. in the German steamer "Neumark," and that was a new and bold departure. Mr. G. A. Crawford, of Canadian Pacific Steamships, Ltd., and Mr. W. Hoy, of the North-Eastern Marine Engineering Company, Ltd., gave some interesting information with regard to the results obtained with combustion chamber superheaters in C.P.R. ships. Superheaters of improved design, Mr. Crawford said, were fitted in the wing chambers of the five main boilers of the "Montrose" in January, and in the record trials a steam temperature of 750 deg. Fah. had been attained. In these particular boilers, the elements were lengthened, bringing the spearheads down into the throat of the furnace. This allowed the surface to be reduced with more space at the back of the elements for examination purposes. The arrangement was very compact. Mr. Hoy said that the joints could easily be made and unmade, and in one installation the element connections had not been touched with a spanner for a whole year. Tests of tubes cut from the elements indicated no change in structure. Mr. Sterry B. Freeman expressed surprise that the Board of Trade passed a radiant heat superheater, and said he was very gratified at the excellent results obtained. Mr. E. Warne referred to the question of tightening the superheater joints under steam, mentioned by the authors, and compared the workmanship and operation of high-pressure water-tube boilers and steam turbines with the internal combustion engine, which he regarded as simpler. Mr. J. D. Heenan spoke of the Foster economiser and suggested that the question of a steaming economiser might well be looked upon by marine engineers as a means of saving space. He suggested that the furnace tanker "G. Harrison Smith," which, he said, was equipped with twin B & W 450 lb. pressure boilers with 730 deg. Fah. total steam temperature, the machinery being of the single-screw, double-reduction turbine type, with a generator driven off the intermediate shaft for auxiliary power. The total consumption for all purposes was 0·6 lb. of oil per S.H.P. hour. On the subject of pulverised fuel for Scotch boilers, Mr. John Reid referred to a ship, now at sea, in which a consumption of 1·25 lb. of coal per I.H.P hour was being obtained with triple-expansion engines and ordinary steam auxiliaries. Such results promised a new field for cylindrical boiler development. Mr. N. Nithsdale and Mr. Summers Hunter, jun., briefly replied, and a vote of thanks was given to Engineer-Captain W. Onyon, R.N. (Ret.). who presided over the meeting.

Hinged Dock Caisson for India.

A somewhat curious caisson for closing the end of a dry dock has recently been built and dismantled for shipment to India, where it will be re-erected at site. It was designed and made at the Barrow Works by Vickers-

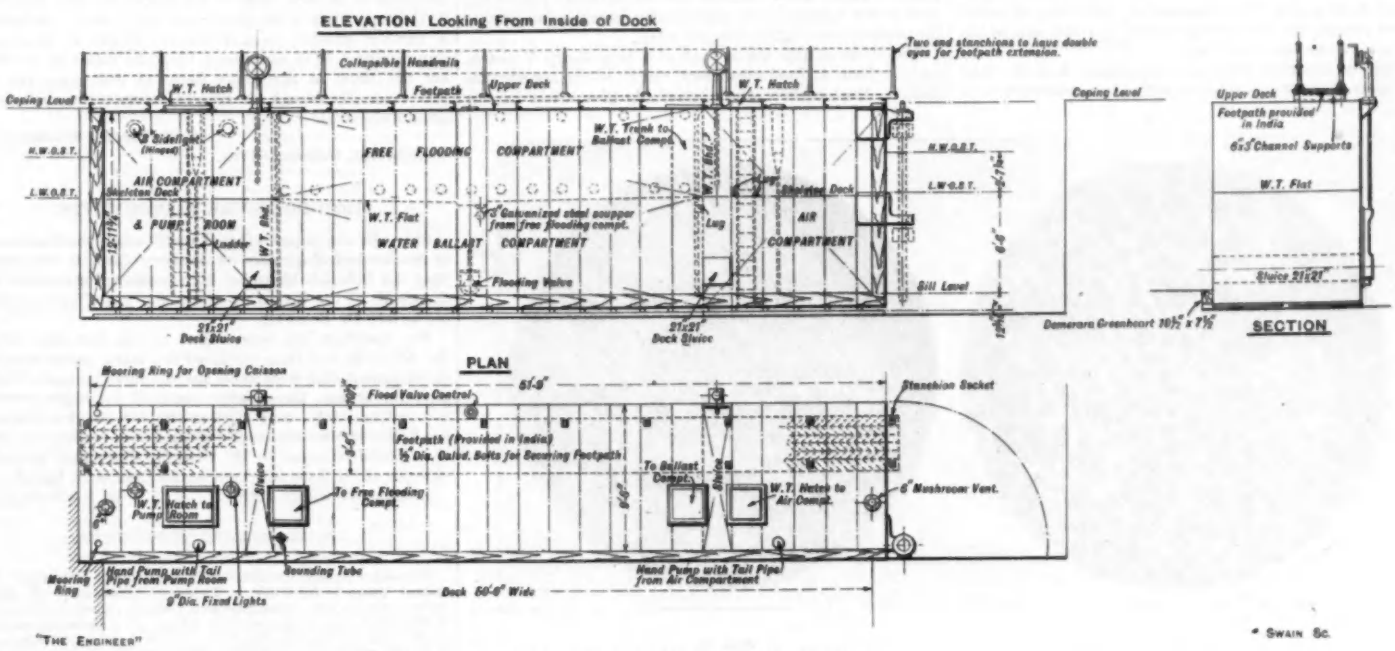
END OF CAISSON

Armstrongs, Ltd., under the supervision of Messrs. Robert White and Partners, of Westminster, on behalf of the South Indian Railway Company, and it will be used for closing the end of a dry dock at Mandapam, which has an entrance opening at various levels of the tide. The difference of level between high and low water of spring tides is, it may be said, only 2ft. 7½in.

It measures 51ft. 9in. long by 9ft. 6in. wide by 12ft. 11½in. deep, and it is illustrated in the accompanying engravings, one of which, showing the hinge pin, was reproduced from a photograph taken while the caisson was under construction at the makers' works. It is built of steel plates, which will be riveted together in India, and it is divided into four compartments, one compartment at each end, measuring some 12ft. long by the width of the caisson, being intended for air or buoyancy chambers. Between the two there are two compartments arranged one above the other, and separated from each other and from the air chambers by water-tight bulkheads. The lower of these two compartments is for water ballast, while the upper is a free flooding chamber which is pierced with a number of holes in two lines, one line near the bottom and the other near the top for the inflow of water and the escape of air, and *vice versâ*. This free flooding chamber is also furnished at the bottom with a 3in. galvanised steel scupper, so that it can be entirely drained of water. Water can be let into the ballast tank through a 9in. Blakeborough sluice valve, which can be operated by a hand wheel from the deck of the caisson.

In one of the air or buoyancy compartments is a centrifugal pump, supplied by Worthington-Simpson, Ltd., of Newark-on-Trent, which is driven by a paraffin engine made by the Record Corporation, Ltd. This pump is designed to pump water from the ballast compartment at the rate of 60 tons per hour. Piercing the caisson from side to side are two rectangular, horizontally arranged water-tight trunks, each of which is closed by means of a 21in. by 21in. sluice gate, and which are for allowing water to enter the dry dock. The valves are operated from the deck of the caisson by hand wheel. Each of the air compartments is furnished with a water-tight hatch, which can be secured by butterfly nuts, and with a 6in. mushroom vent. Access to the floor of the chamber from the roof of the caisson is effected by ladder. There is a hand pump for each compartment, to remove overboard any water which may collect on the floor. The compartment containing the ballast tank pump is also illuminated by a couple of 9in. fixed lights. Each of the free flooding compartments is closed by a grated hatch.

Green-heart bearing timbers, 10½in. by 7½in., are carried round the dock side of the caisson to ensure a water-tight bearing surface against the masonry. On arrival in India a footway running from end to end of the caisson is to be fixed and stanchions for hand rails. Over this side the makers have fixed channel sections to carry the floor of this woodway. Mooring rings for opening and closing the caisson have also been fitted at deck level.



HINGED DOCK CAISSON FOR MANDAPAM

CANAL DEVELOPMENTS IN THE MIDLANDS.

It is reported that the Grand Union Canal Company, which, two years ago, brought under unified control five canals operating between London and Birmingham, has made arrangements to buy three more canals at the northern end of its system. The arrangements are subject to ratification and Parliamentary sanction. The canals to be acquired have a total length of 37 miles. They are the Leicester Navigation—16 miles long—the Loughborough Navigation—9 miles long—and the Erewash Canal—12 miles long. The acquisition of these three Midland canals, which link up the London-Birmingham and Leicester-Birmingham system with the Trent Navigation, is the most important canal development in this country since the formation of the Grand Union Canal Company by the amalgamation of the Regent's Canal and Dock Company, the Grand Junction Canal Company, the Warwick and Napton Canal Company, the Warwick and Birmingham Canal Company, and the Birmingham and Warwick Junction Canal Company. The immediate result of the purchase will be to give the coalfields of Nottinghamshire and Derbyshire and the Leicestershire quarries a direct waterway to London. The system will also give access to the ironworks of the Erewash Valley and the electrical engineering works of the Loughborough district.

gases should be taken off at 1300 deg. to 1400 deg. Fah., and reduced to 500 deg. Fah. at the air heater by high velocity economisers tubes. In a Scotch boiler using gases at 800 deg. to 900 deg. Fah., he suggested that a 30 to 50 per cent. increase in evaporation might be obtained on those lines thus requiring fewer boilers. Major W. Gregson, of Babcock and Wilcox, Ltd., gave particulars of the

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE FAILURE OF FLAT-BOTTOM STEEL RAILS.

SIR,—I was greatly interested in Mr. Huddart's—Works Manager, Egyptian State Railways—article published in your issue dated December 12th, 1930, but I cannot agree with his deduction that the "lap" has no effect on a rail in a "normal" state of structure. This statement is not coincident with the experience of this inspectorate. After perusing the article, slices were cut from a rail which had failed in the track at the junction of the web and foot. These were normalised at approximately 820 deg. Cent.

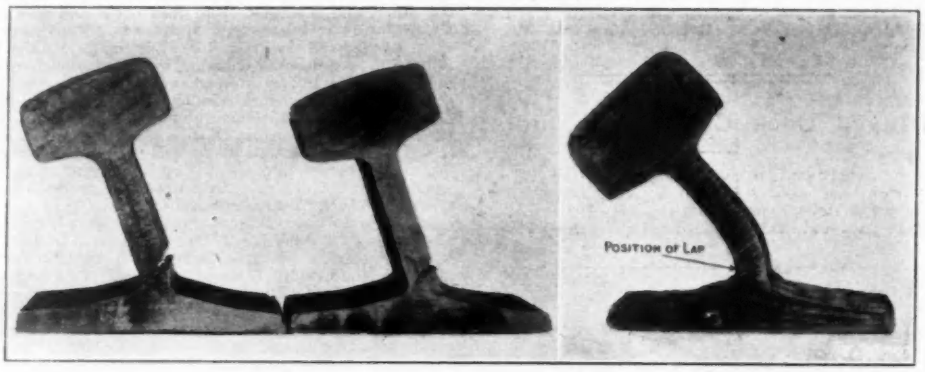


FIG. 1—AS RECEIVED NORMALISED FIG. 2

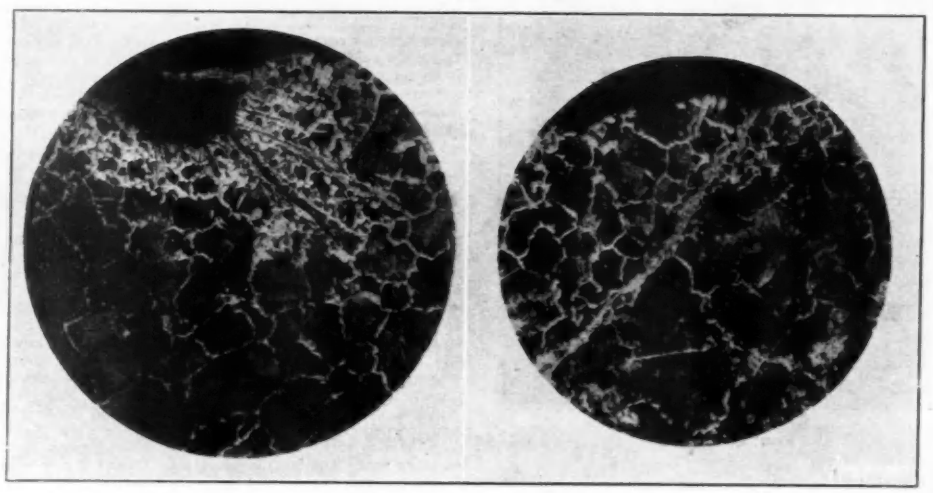


FIG. 3 FIG. 4

Slices were also taken for test from the rail "as received." One single blow of a 10 lb. hammer in every case fractured the rail pieces, the blow being delivered on the side of the head above the lap—see Fig. 1.

It will be observed from the photograph that the fracture was not quite so complete with the normalised as in the case of the untreated rail, but the difference is small, and would certainly not affect the behaviour of the rails in the track.

The effect of sixteen blows of a 10 lb. sledge hammer on other slices of the same rail, the blow being delivered on the opposite side of the head, can be seen in Fig. 2. The web has been bent through a considerable angle without sign of fracture.

Mr. Huddart appears to be under the impression that the lap is always visible on the surface of the rails, but this is by no means the case. While it is true that a trained inspector may be able, in certain instances, to detect the presence of this lap or flaw, yet many hundreds of tons of rails have been rejected by this inspectorate on the results of the hammer test, the lap being so minute that it could only be detected by the microscope after suitable preparation of the section.

A lap which was responsible for the largest batch of rails ever rejected by this office is seen in the accompanying photograph—×120 diameters—Fig. 3.

This lap was just visible to the naked eye, while in the next photograph—Fig. 4—also ×120 diameters, the flaw was absolutely invisible on the surface of the rail, and could not be detected, even with the aid of a magnifying glass. Failure under hammer test immediately placed the rails under suspicion and microscopic examination proved the presence of a highly dangerous lap.

The effect of this lap is that of a very sharp V notch, and no form of heat treatment can possibly remedy the defect. High-carbon steels invariably give a low impact value under Izod or impact test, and any form of heat treatment will never render rails showing this defect a safe proposition in the track.

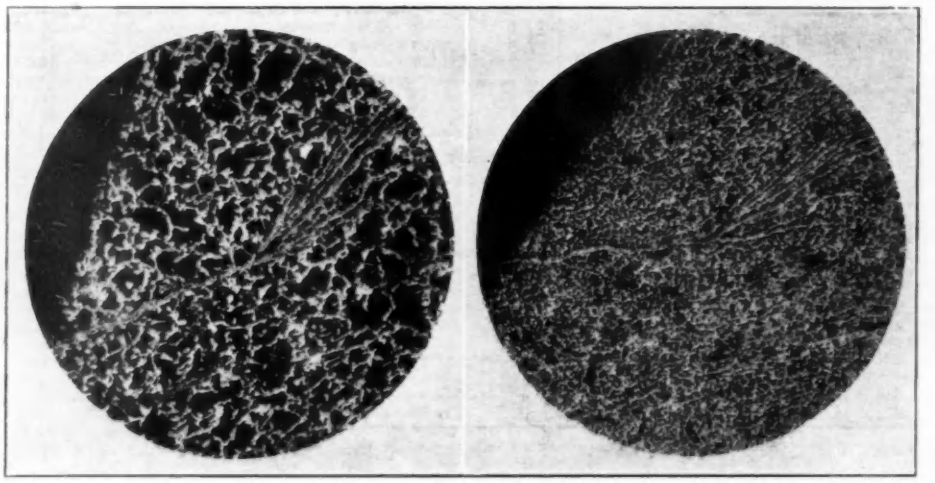


FIG. 5 FIG. 6

Figs. 5 and 6—×120 diameters—show a lap invisible to the naked eye, but detected first by the hammer test, and subsequently by the microscope. Fig. 5 shows the structure of the rail "as received," together with the lap; Fig. 6 was taken from an adjacent slice after normalising.

The specification to which the rails are being supplied to the Egyptian State Railways appears less rigid than that of the Indian State Railways, the phosphorus and sulphur content being limited in the latter case to 0·05 per cent. except in the case of 50 lb. or lighter rails, where a phosphorus content of 0·06 per cent. is allowed.

It is very difficult to reconcile a Brinell number of 383, with a tensile test of 47 tons, and a carbon content of 0·47 per cent. Assuming a factor as low as 0·21 for converting the Brinell equivalent into tensile stress, this rail should have given a tensile strength of just over 80 tons per square inch.

I cannot agree with the opinion of Mr. Huddart that rails containing high carbon and manganese are susceptible to ordinary atmospheric conditions. Many thousands of tons of rails rolled in India have undoubtedly been exposed, during cooling, to the effects of the wind and heavy rain during the monsoon period, but failures are a very rare occurrence. It is true that drop test pieces tested during the monsoon have in the past occasionally failed to stand the second or even the first blow of the tup, but such failures have invariably been traced to the carelessness of the workers, who recklessly throw the hot sawn ends outside the mill into pools of water or in a position where heavy rain from the roof descends in a steady stream upon the drop test pieces.

Some years ago this inspectorate undertook a lengthy investigation on the effects of rolling temperatures and rates of cooling, but the results obtained merely pointed to the fact that such factors had but little influence on the tensile strength or impact value of the rails.

It is extremely difficult to pronounce any definite opinion as to what constitutes a satisfactory rail. It is by no means certain that a high carbon or "hard" rail will give the best service in the track, and there are many cases on record where rails have given an extraordinary length of life, but whose composition would cause consternation to a metallurgist or chemist in view of more modern specifications.

No satisfactory test has yet been devised by which the probable life of the rails in the track or their resistance to wear may be determined, and it is possible that when such a test is devised, all pre-conceived ideas may be overthrown.

E. A. WRAIGHT, Metallurgical Inspector.

Indian Stores Department,
Tatanagar, B.N.R., January 20th.

THE "ROCKETS."

SIR,—I have asked Messrs. Robert Stephenson and Co. whether anything can be found to throw light on the construction of the "Comet." They have very kindly searched their records, with the following result:—

"The 'Comet' is recorded as 'No. 4,' constructed May, 1832, and finished May 5th, 1832. There is a note in the book to say that the boiler is nearly the same as the 'Phœnix.' Generally speaking, the records are similar to those for other new locomotives and there is nothing to show that this engine was a rebuild from an earlier type. There is a reference in an old Price Book, dated 1832, to 'The cost of Cranked Axle for Leicester "Commet"' (*sic*) giving prices and weight, the latter being 7 cwt. The reference to the 'Phœnix' is evidently intended for the Leicester and Swannington engine, which comes next in sequence in the book; finished August 28th, 1832."

The date of the entry is uncertain; it is after one of September, 1833, and before one of November, 1832.

It is, therefore, certain that the engine had inside cylinders at an early stage of her career on the L. and S.R. So the supporters of the ghost story will have to incorporate a further drastic reconstruction, which is extremely improbable. It is significant that the dates of finishing are the same as Stretton's dates of delivery. His list was evidently based on correct information, not quite accurately used.

C. F. DENDY MARSHALL.

Guildford, February 17th.

HIGH-PRESSURE LOCOMOTIVES.

SIR,—In the paper which I read before the Institution of Mechanical Engineers on January 23rd, it was stated that the Schmidt-Henschel high-pressure locomotive was the result of the invention and many years' investigation of the late Dr. Schmidt.

My attention has been called to the fact that whilst Dr. Schmidt had been occupied for many years with the development and with trials for the introduction of high-pressure steam, these were confined to single-pressure locomotives only, and that credit for the invention of the Schmidt-Henschel high-pressure, two-pressure locomotive should be given to Mr. Otto H. Hartmann, technical director of the Schmidt Superheater Company, Cassel.

London, February 16th. H. N. GRESLEY.

FARADAY HOUSE ELECTRICAL ENGINEERING COLLEGE.—The annual examinations for a Faraday Scholarship of eighty guineas per annum, tenable for two years in college and one year in manufacturing works, and for a Maxwell Scholarship of sixty guineas per annum, tenable for two years in college and one year in works, will be held at Faraday House on March 31st, April 1st, and 2nd, 1931. Exhibitions may also be awarded to candidates who acquit themselves creditably in the above examinations, but who do not obtain the necessary number of marks to qualify for the Faraday or Maxwell Scholarship. The subjects of examination for the Faraday Scholarship are geometry, algebra, trigonometry, dynamics, statics and hydrostatics, geometrical and freehand drawing, chemistry and physics. For the Maxwell Scholarship the subjects are mathematics, dynamics, statics and hydrostatics. Further particulars may be obtained from the Registrar, Faraday House Electrical Engineering College, 62–70, Southampton-row, London, W.C. 1.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

No Improvement.

THE general trade position in the basic industries of the Midlands and Staffordshire remains unchanged. Heavy and structural engineering firms are uniformly quiet, and there seems little prospect of any immediate improvement, inquiries being extremely few and light. The demand for iron and steel, except for special varieties, continues to be much below normal and producers are very concerned as to the future. It is realised that manufacturers, who have to compete with their finished goods, are increasingly going for their raw material to the sources where they can buy to best advantage. Continental quotations are, in many cases, pounds below home makers' prices, and foreign iron and steel are coming into the district in increasing quantities. Native iron and steel makers assert that they cannot reduce their prices while costs of production remain so high. Buying is at a low ebb and the market is almost stagnant. Interest and attendance this week has been divided between the Exchange and the British Industries Fair, for industrialists are anxious to glean any information which would point to better business in the future, and the B.I.F. is expected to contribute something tangible to future Midland industrial activity.

Pig Iron Consumption.

Midland foundries, with a few exceptions, are less regularly employed than they were a few months ago, and their material requirements are relatively small. But for this it is just possible that Northamptonshire blast-furnacemen would have received better orders just now. Had business remained even at the level it was in December last local smelters would have benefited by reason of the fact that contracts placed some months ago for Luxemburg iron have now been completed, and as there is now no advantage in price, they are not being renewed. District furnaces should have benefited by this displacement, but, unfortunately, foundrymen's requirements have become less, and they are not under the necessity of increasing the volume of the orders recently given to Northamptonshire and Derbyshire smelters. Furnacemen are, however, satisfied that there is no more continental iron being ordered, and that they themselves will supply the whole of the foundrymen's requirements. Though demand is admittedly bad, stocks at the furnaces are said to be steadily, if slowly, decreasing. In Northamptonshire they are not nearly so large as they were a couple of months back. Prices are unchanged at £3 7s. 6d. for Northamptonshire No. 3 and £3 11s. for Derbyshire. Any reduction in the near future is considered to be unlikely. Blast-furnacemen do not hesitate to inform customers that present selling prices do not leave a wide margin of profit.

Poor Demand for Steel.

Purchases of steel are limited to small quantities, and the big steel works, with plant equipped to turn out thousands of tons a week, have to be content with a small output for a few days each week, usually consisting of small miscellaneous orders. Demand has seldom been so flat in the steel branches. The requirements of all the consuming industries are very poor. Prices for heavy steel are everywhere quoted at the minimum rates, namely, £8 7s. 6d. for angles, £8 15s. for joists, and £8 17s. 6d. for ship, bridge and tank plates. Many Midland constructional engineers have only sufficient work to last them till the end of the quarter. They claim to be sending in as many specifications as possible to the steel works. Boiler plates are not in such good demand as they were. Values are firm, however, at £9 5s. Users of semi-finished materials, which are still subject to free bargaining, endeavour to obtain further price concessions, and they occasionally succeed. In very few cases, however, is there business of any magnitude within reach, and producers are not easily persuaded to make concessions to gain the small amount that current orders represent. Re-rollers of continental material quote £7 7s. 6d. for small re-rolled bars. Mild steel billets are named £5 10s. upwards. Staffordshire hoops sell fairly well at £9 10s. at makers' works. Very few new orders are being given out for foreign steel, but considerable tonnages continue to be received on account of orders placed some time ago.

Finished Iron.

Dull conditions continue in the finished iron mills of South Staffordshire, where specifications are very difficult to secure. Plants are working intermittently and the tendency is towards less active conditions. Comparatively, the marked bar makers are better off than other producers. They have not received anything like the quantity of work which they expected in the first quarter, however. Selling prices are upheld at £12 10s. at makers' works, there being little justification for anticipating any compensating increase in consumption if millowners reduced values. Recent inquiries for Crown bars have not as yet led to any influx of orders. Price stability is not a strong feature in this or the common bar department. There are no big orders about, however, to tempt millowners to try the effect of a further easing of selling terms. They quote £9 15s. upwards for merchant bars and £8 15s. upwards for nut and bolt and fencing bars. Wrought iron tube strip commands about £10 17s. 6d. per ton delivered. Belgian No. 3 iron is freely offered at special prices, but buyers are difficult to find. When orders are secured, they are usually for very small tonnages, to the chagrin of continental agents and importing merchants.

Galvanised Sheets.

The sheet market in this district shows no improvement and quotations for galvanised sheets are unchanged at £11 a ton for 24-gauge corrugateds. Millowners assert that this figure is low enough to attract business, consequently it is evident there is but a small consumptive demand. The recent reduction has been of very little, if any, use in bringing new orders. The home trade is taking regular and moderate supplies, but the export business is lifeless.

Furnace Coke.

The coke market is weak. Producers of good quality blast-furnace coke quote as much as 12s. a ton at the ovens, but they would, probably, meet the consumer at a little below this figure for a good contract.

Trade Reviews.

Extensive reviews of the national industrial position, including also references to the depression and the abuse of unemployment and a bitter denunciation of British Governments, characterised the speeches at the annual dinner of the South Staffordshire Iron and Steel Institute, at Dudley, on Saturday last. The President of the Institute, Mr. T. Hoskinson, was in the chair. Proposing the "Iron and Steel Trades," Mr. Henry Clay, late Professor of Social Economics in the University of Manchester, said the depression in the trade of the country was one of the worst during the last hundred years, and the usual external indications of improvement at present gave very little cause for encouragement. One of the greatest obstacles to a general revival of trade in the near future was the enormous accumulation of stocks in most of the staple industries of the country. A contrast would show that we had lost ground in the world's trade not only with countries that had had stabilised prices on a low level, but with those that had stabilised prices on a high level. They were told that the extension of the present difficulties in this country was owing to the world's trade depression of 1930, but, before that year, this country suffered from a greater depression than American and several European countries. Colonel J. S. Trinham—N. Hingley and Sons, Ltd.—replying to the toast, said the British Government had never lifted a finger to help the iron and steel industries of this country. When he was in France he saw some fine up-to-date works, and when he asked where the money came from, he was told that it had not been subscribed by those engaged in the industry, but had been given or lent by the Government. What had happened in this country? The iron and steel manufacturers worked together and did their best to supply war materials to the allied countries incapable of meeting their own requirements; but, when the war was over, the Government, instead of helping them to buy new plant, hampered their progress by excessive taxation. It was no use Mr. Snowden preaching economy now; it was too late. The iron and steel manufacturers were told that they made idle excuses for their lack of enterprise, and that they could do better. The fact was that they were being bled to death. The "dole" had become a payment for unemployment. Colonel Trinham bitterly criticised the abuse of unemployment benefit and complained of the high cost of social services. But for taxation arising from the cost of social services, he said, the price of iron and steel could be reduced by 6s. a ton. If the steel annually arriving in this country from abroad were produced at home, it would represent a consumption of 12,000,000 tons of coal, and the employment that would be found by this increased production of steel and coal would mean an enormous reduction in expenditure on the "dole." Colonel Trinham added: "I can hardly see the manufacturers putting up with the present general state of affairs any longer. We are just about at the end of our tether."

The Chain Trade.

The chain trade in the Netherton and Cradley Heath areas of the Black Country is very depressed at date, and the outlook is reported to be very poor indeed. Although manufacturers here are holding their own for trade of the best quality workmanship, business has dropped off steadily since the end of last year, owing to lack of demand. Foreign competition is still keenly felt in the cheaper qualities and district makers have few orders on their books for this class of chain.

Unemployment.

Last week's reported decrease of 234 in the number of unemployed in the Midlands area has been swallowed up, the latest returns showing an increase of the week of no less than 5035. This brings the total to 360,706, which is 166,787 higher than at the corresponding week twelve months ago. The total comprises 241,422 men, 102,416 women, 8064 boys and 8804 girls. Unemployed in Birmingham number 62,208, an increase of 1934 on the preceding week. Higher figures are also recorded at Bilston, Cradley Heath, Coventry, Kidderminster, Leamington and Warwick, Leicester, Nottingham, Oldbury, Peterborough, Redditch, Tipton, West Bromwich and Wolverhampton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Poor Start.

IF the January values of exports of textile machinery are a foretaste of what is to come this year, manufacturers in this branch of engineering are in for a poor time. Last month's shipments amounted only to 4898 tons, valued at £515,858, compared with 9060 tons and £863,671 in January of last year, and 11,618 tons and £1,055,027 in the corresponding period of 1929. Last month's exports included 3782 tons of spinning and twisting machinery, valued at £387,995, and 652 tons of weaving machinery, valued at £63,993. While shipments to all markets have declined heavily, some make a much worse showing than others, notably British India, Russia, Germany, the Netherlands, Japan, the United States, South America, and Australia. British India, however, continues to occupy first place, with exports valued at £168,258, followed by China with £57,083, France £55,233, the Netherlands £19,615, Russia £19,578, Germany £15,137, the U.S.A. £14,410, South America £12,681, Japan £10,719, and Australia £3710, the month's shipments to "other European countries" reaching an aggregate value of £103,890.

Steel Works Developments.

One or two interesting facts bearing upon the development work in progress at the Partington branch of the Lancashire Steel Corporation were given by Mr. J. Sinclair Kerr, the managing director, in a lecture a day or two ago. Mr. Kerr stated that the output of the new coke oven plant will be between 5000 and 6000 tons a week, and the extensive utilisation of blast-furnace and coke oven gases in the steel plant is a prominent feature of the development programme, which includes also the transfer of the manufacture of foundry iron and ferro-manganese from Wigan to Partington, the erection of steel furnaces—claimed to be the largest in the country—with an annual capacity of 400,000 tons of ingots, and the installation of a cogging mill capable of rolling 5-ton ingots. The Steel Corporation also propose to increase the production of iron and steel castings and to develop non-ferrous metal castings. As was indicated in this column last week, a start will be made shortly with the construction on the Manchester Ship Canal, in front of the Corporation's blast-furnaces, of a dock 600ft. in length and equipped with machinery capable of unloading about 4000 tons daily.

Industrial Results.

Reduced profits, or profits transformed into losses, are the features of several financial statements issued by Lancashire engineering companies during the past week. The directors of Crossley Brothers, Ltd., engineers, of Openshaw, Manchester, announce a net profit for the past twelve months of £30,205, compared with £60,340 in the previous year, and regret is expressed that they cannot recommend the payment of the preference dividend for the second half of the year. Owing to the world trade depression, particularly in the North of England, which has seriously affected sales, Crossley Motors, Ltd., of Gorton, Manchester, report a loss for the year of £49,823, against a profit of £2025 a year ago, and after deducting the amount brought in there is a debit balance of £44,118 to be carried forward. A loss of £62,263 for 1930, compared with a profit of £21,585 in 1929, is reported by the directors of Willys Overland Crossley, Ltd., motor car manufacturers, of Heaton Chapel, near Manchester, and no dividend is to-be paid on the preferred ordinary shares, a credit balance of £4113 being carried forward. In the case of Mather and Platt, Ltd., engineers, of Newton Heath, Manchester, a total dividend of 10 per cent. on the ordinary shares for the past year, compared with 15 per cent., including bonus, for the eight previous years, was reported last week. Detailed financial results have since been published, and these show a reduction in the net profit of £132,946 from £269,308 in the previous year.

Obituary.

The death occurred on February 11th at Hawarden, North Wales, of Mr. William Nelson Bower, consulting engineer, of Manchester. Mr. Bower was a well-known member of the Engineers' Club, Manchester, and of the Institution of Mechanical Engineers and the Institution of Electrical Engineers, and was the managing director of Carbic, Ltd., acetylene specialists, of Trafford Park, Manchester. Mr. Bower was responsible for the electrification of many important cotton mills in Lancashire, and acting as consulting engineer to a number of the leading textile firms in the county, including Tootal Broadhurst Lee and Co., Ltd., and the Fine Cotton Spinners' Association.

Non-ferrous Metals.

So far the recently improved tone of the non-ferrous metals market has been maintained, and despite occasional setbacks, further advances have occurred in both copper and tin. On balance, lead has lost some of the ground gained a week ago, but spelter has about held its own. In the case of copper, the firmer tendency of values has attracted rather more interest from consumers, and a fair volume of speculative buying has also been reported. Standard brands are roughly 10s. a ton dearer on the week, both for prompt and forward metal, with corresponding advances in refined descriptions. Tin is dearer by almost £1 a ton, and although up to the present time there has been no appreciable improvement in the consuming trades in this country, there is a tendency to regard the outlook in a somewhat more hopeful light. In the meantime, there has been a further increase in British stocks of the metal. As stated, a certain amount of reaction has been experienced in the lead section, values being lower on balance by about 5s. a ton, with only moderate sales reported. There has been no apparent expansion of the rate at which spelter is being taken into consumption, but there is a certain amount of satisfaction to be derived from the fact that last week's advance has been about maintained.

Iron and Steel.

The demand for foundry iron on the Lancashire market this week has shown no sign of broadening, and certainly little inclination among users to enter into forward commitments. What the spring will bring in the way of revived interest in both foundry iron and steel is problematical, although sellers of both are not without hope of better things. Pig iron prices are steady at 69s. 6d. per ton for Staffordshire and Derbyshire, 68s. for Northamptonshire, about 71s. for Cleveland, from 90s. to 91s. for Scottish makes, and 82s. 6d. for West Coast hematite—all for delivery equal to Manchester. There has been no quotable change in the position of Lancashire bar iron, Crown quality material being at £10 5s. per ton and No. 2 at about £8 15s., with sellers continuing to report poor order books. Prompt rollings and quick deliveries are the order of the day in the case of home-produced steel, orders this week having been both few in number

and of relatively small tonnage in the aggregate, the long-awaited improvement in the general position of constructional engineers, boilermakers, and locomotive builders in the district apparently being as far away as ever. Small re-rolled bars are not too strong at from £7 to £7 2s. 6d. per ton, and the same may be said in respect of acid and basic boiler plates, which are quoted here at about £9 5s. per ton. Other materials are maintained at £8 17s. 6d. for tank plates, £8 15s. for joists, £8 7s. 6d. for sections, and £9 7s. 6d. for large bars. After a spell of weakness and falling prices, quotations for imported iron and steel materials for delivery in the Manchester district have moved up during the past week in consequence of a jump in freight rates from the Continent. Siemens plates are quoted for delivery to Manchester users at £5 18s. per ton, angles at £5 2s. 6d., wire rods at about £6, billets at £4 8s., and bar iron at £5 1s. 6d. As before, however, sales have been confined to a few small parcels.

BARROW-IN-FURNESS.

Hematite.

There is no sign of active life in the hematite pig iron market as yet. Fortunately, the steel departments at Barrow and Workington are taking a fair tonnage, but otherwise the recent cut in price has so far not tempted buyers to buy on a bigger scale. It is difficult to see at present prices where the margin of profit comes in; in fact, it is suggested that there is no margin at all. Trade is dull from every point of view, home and overseas. Business with the Continent has not been brisk for some considerable time, and there has been an absence of substantial shipments to America of late. The iron ore trade is just moderate. Outside business in native ores is poor and local demands are limited. Foreign ores are coming in in restricted tonnage. The steel trade is not over bright, and although Barrow and Workington are on railway material fresh contracts would be very welcome indeed. The prospects are a little better than they were some months ago, but there is nothing to be enthusiastic about at the moment.

Shipbuilding.

Although Barrow is moderately well fixed for work at the moment, the outlook is none too bright. No fresh contracts have been booked for large merchant ships for a long time, and when the two P. and O. liners are completed there will be nothing to take their places. That means that a large number of men will be displaced. There is Admiralty work it is true, but it does not provide employment to the same extent as do liners with their vast and elaborate accommodation.

SHEFFIELD.

(From our own Correspondent.)

Open-hearth Steel.

THE heavy side of steel production in the Sheffield district shows some little improvement. The additional open-hearth furnaces which were put into commission at the Templeborough works of the United Steel Companies after the holidays, to deal with arrears of work which had accumulated during the stoppage, are still employed, and several other local plants are working better than in December. It is questionable, however, whether orders are coming forward in sufficient bulk to warrant a long continuance of this activity. There is so little buying on a large scale, and such a dearth of substantial inquiries, that it may be necessary shortly to revert to the standard of output that prevailed before Christmas. In North Lincolnshire three furnaces are in commission at the Appleby works and five at Lysaghts, but the plants at Redbourne Hill and Frodingham are still idle. The blast-furnaces operating in Lincolnshire at the end of January were two at Lysaghts, and two out of six at Appleby, those at Frodingham being still set down. The Parkgate Iron and Steel Company has two blast-furnaces working out of three.

The General Position.

Not only in open-hearth steel, but in the trade as a whole, conditions continue quiet, and signs of improvement are still anxiously awaited. In a few directions only can increased booking of orders be reported. There is a fair amount of activity in hollow rolled forgings for boiler and other drums, and moderate briskness also characterises the trades in cold rolled strip and high grade wires. The call for motor car steel remains at previous levels, a good deal being required in connection with the building of heavy commercial vehicles, but less than the average for touring cars. The call for alloy steels, although still on a substantial scale, is below that of any part of last year. Railway work is very disappointing. While there are good orders on hand for patent buffers, the departments devoted to axles, tires, and springs remain very slack. The home railway companies are requiring less than usual, in consequence of reduced traffic and lessened wear and tear, and they are also economising as much as possible, and reducing their specifications to the minimum. Apart from locomotive building, the overseas demand for railway material is small. There are inquiries out just now, from the Bengal and North-Western Railway Company, for 2064 locomotive, carriage and wagon steel tires, and also for 150 tons of dogspikes.

Uses of Stainless Steel.

One of the most satisfactory departments is that concerned with the production of stainless steel and with the more recently developed acid, corrosion, and heat-resisting steels. The demand for these products is well maintained, and, as new uses for them are continually being found, the outlook is promising. The extent to which Thos. Firth and Sons' Staybrite patented D.D.Q. steel is applicable to the lighter trades of Sheffield was dealt with by Dr. W. H. Hatfield, of the Brown-Firth Research Laboratories, in a lecture which he delivered last week to the Sheffield Trades' Technical Societies. He said that the combination of easy workability and excellent corrosion-resisting properties had resulted in the use of this steel for purposes hitherto regarded as the province of the non-ferrous metals and alloys. The steel was totally resistant to all foods, liquids, and other domestic commodities. The directions in which the steel was being very successfully and extensively applied included spoons and forks, knife handles and knife scales, and other articles of a domestic character; general hardware, hotel, restaurant, hospital equipment, and shop fittings. P. R. Kuehnrich and Darwins, Ltd., of Sheffield, have taken out a patent for the heat treatment of alloy iron and steels. According to the specification, articles made from alloy irons and steels, containing 8–20 per cent. of chromium and 1–3·5 per cent. of carbon, with or without up to 6 per cent. cobalt, and up to 1 per cent. each of nickel, vanadium, molybdenum, silicon and manganese, and containing sulphur and phosphorus as non-essential impurities—less than 0·05 per cent. of each—are hardened and rendered stainless and rustless by heating to a temperature between 1150 deg. and 1250 deg. Cent., and, when uniformly heated to this temperature, cooling at a definite rate corresponding to the rate at which steel in sheet form of about 18 gauge cools in water at normal temperature. This cooling is effected for articles in sheet strip form of thickness not exceeding 18 gauge by quenching in water at 15 deg. Cent.; for articles up to 12 gauge thickness, *e.g.*, spoons and forks, by quenching in a solution of calcium chloride or sodium chloride; and for tramcar fittings and castings generally by quenching in iced water or iced chloride solutions.

Good Orders for Pipes.

The cast iron foundries in Derbyshire are fairly well employed, and are growing busier on various gas and water schemes which are to be put in hand now that the season for excavating work is approaching. Two good orders are reported this week. One, which has been placed with the Staveley Coal and Iron Company, Ltd., for the supply of pipes for the Royd Moor water scheme, Barnsley, is valued at £36,000. Another, booked by the Stanton Ironworks Company, Ltd., from the Derby Gas Light and Coke Company, is for a main no less than 16 miles in length, consisting of 12in. and 15in. diameter de Lavaud spun iron pipes, fitted at each length with Stanton-Wilson flexible joints. The pipes are to be used for connecting up the Belper gasworks with coke ovens at Clay Cross and Blackwell. Coke oven gas is to be transmitted from batteries of ovens at the two latter points, and is to be purified at Belper and passed into the service mains. A point of special interest about this installation is that flexible joints are being used in connection with cast iron pipes for protecting the main against possible subsidence of the ground and against vibration resulting from road traffic.

Cutlery and Plate.

The sales of cutlery and plate usually expand with the progress of the season, but this year they are showing a declining tendency, and there is an increase of short time at the factories. There has been a considerable fall in the output of stainless knives this year, and the demand for goods by the cheap bazaars also shows a decline. There is still a large output of a variety of articles for coupon distribution. The export trade is suffering from a drastic curtailment of buying by most of the overseas countries. Exports of cutlery during January were of a total value of £45,748, as compared with £66,639 in January last year and £99,555 in January, 1929. The Australian return showed a very serious drop, the recent figure being only £7576 as compared with £20,476 last year and £29,994 the year before. There was an increase in exports to Canada, which was the only market to show a gain. The overseas trade in safety razors held its own fairly well. The January imports of cutlery amounted to £35,042, a figure which was £10,000 in excess of that of December, and £13,000 more than that of January last year, but nearly £50,000 less than that of January, 1929. Sheffield cutlery firms are well represented at the British Industries Fair at Olympia, and early reports indicate that good business is being done. Several novelties are being exhibited. There are complaints that although the safeguarding duty on cutlery lapsed only two months ago, German competition is increasing, especially in safety razor blades of the cheapest type. A letter has been published in which a German firm offers to sell blades in the United Kingdom at £2 per 1000, for which it charges £3 3s. per 1000 in America. The work of the recent Sheffield Mission to South America is being vigorously followed up. A South American section of the Chamber of Commerce has been formed. The samples of foreign goods sold in South America, collected by the Mission, are now on view in Sheffield, and the exhibition was opened last week by Mr. G. M. Gillett, Minister in Charge of the Department of Overseas Trade. The goods cover a wide range of cutlery and light steel products, and are very instructive to local manufacturers.

Sheffield's Trade Name.

Good work for the protection of Sheffield's trade name against unfair use continues to be done by the Sheffield Advisory Committee. The report adopted at the annual meeting last week gave several instances of this valuable activity. One related to the labelling of French spades, "Sheffield English Steel Spades." A statement of the facts was placed before a French *avocat*, who advised that it would not be safe to take proceedings in France unless it could be proved that the steel from which the spades had been made was not manufactured in Sheffield The matter was then reported to the Board of Trade, who made representations to the Foreign Office. A letter has since been received from the Board of Trade stating that his Majesty's Ambassador in Paris has been informed that the manufacturer of the spades in France has given an undertaking to discontinue the use of the objectionable labels.

Water Schemes.

Several schemes of interest to water engineers are in prospect in Yorkshire and neighbouring counties. At Otley there is a difficulty with regard to the supply to a number of hillside houses on the West Chevin. An auxiliary supply, used in the past, has been discontinued because of complaints as to the hardness of the water. While the main reservoir is sufficient to supply the whole town, the trouble is one of distribution. One suggestion that has been put forward is the construction of a service reservoir, at a cost of £10,000. The matter is being investigated by a sub-committee of Otley Urban Council. Belper Rural Council is protesting against a proposal of Alfreton Urban Council to sink a 9in. bore-hole near Lee Hall, on the ground that it will seriously interfere with its springs, and is asking the Ministry of Health to hold an inquiry into the matter. Scunthorpe Urban Council, anxious to safeguard its supplies twenty years hence, is proposing to buy farm land at Broughton, to be developed as a water undertaking at a cost of £40,000, and has asked the Ministry of Health for a provisional order. There is opposition to this proposal on the part of Brigg, and a regional scheme for North Lincolnshire has been suggested.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THERE are no new features of moment in the Cleveland pig iron trade. Transactions are still mainly purchases of small lots by home consumers for early delivery. Demand from overseas keeps light, and business with firms in Scotland is as difficult as ever, owing to the comparatively cheap rates at which foreign material is offered to pig iron users across the Border. Prices are steady, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Export sales of East Coast hematite pig iron are few and small, but a steady home trade is passing. Fairly good supplies are going to the Sheffield district and to the Midlands. Consumers are able to cover their requirements on the basis of 69s. for ordinary kinds, but, while both merchants and makers have sold on those terms, some of the latter are holding out for a higher price. An encouraging feature is that U.S.A. consumers are taking a renewed interest in ferro-manganese produced in this district, a sale of 2000 tons having been arranged this week.

Ironmaking Materials.

Foreign ore consumers are well placed as regards supplies and are off the market. The nominal price of best Rubio remains at 16s. c.i.f. Tees. Blast-furnace coke is plentiful, and local users are buying sparingly. Good average kinds are 16s. 6d. to 17s., delivered to works in this district.

Manufactured Iron and Steel.

Quotations for the various descriptions of manufactured iron and steel keep steady. Orders are urgently needed, but increased activity in connection with railway requisites and constructional material is responsible for welcome expansion in the aggregate tonnage output of steel. Sheets are only in moderate request, and semi-finished commodities are slow of sale.

Tees-side Steel Orders.

The Tees-side Bridge and Engineering Works, Middlesbrough, has obtained contracts for 1000 tons of railway chairs for the L.M.S. Railway and 3000 tons for the L.N.E.R. Other orders placed this week with Tees-side firms are:—Pease and Partners, 5000 tons for L.M.S.R., and 5000 tons for the Southern Railway: Head, Wrightson and Co., 5000 tons for Southern Railway.

The Coal Trade.

With a good demand for best qualities of steam coal, combined with some reduction in output, a result of the influenza epidemic, the tone of the Northern coal market is firm, and supplies for shipment during the next week or two are scarce. Heavy bookings under old contracts are reported, and supported by a small volume of new business only odd lots are obtainable, while turn-books are well filled with definite or earmarked tonnage. It is not yet safe to judge what the effect of shorter hours may be in the coalfields by the results of a single month, but in Northumberland the initial experience has not brought about any great change in cost of working. The 7½-hour shifts began in December, and an analysis of the trading figures for that month shows that wages costs were up 1·14d. per ton on the average for the year. Costs other than wages were higher by 0·36d. per ton, and the trading profit was less than the average by 0·73d. per ton. When the Act has been operating, say, for six months, it will be easier to estimate its general effects. Best Northumberland steam coals are distinctly firmer in tone at 13s. 6d. Tyne prime steam coals for prompt shipment are firm, but orders for delivery over a period are not coming forward, and supplies are likely to become a little more plentiful in the near future. Values are steady at 15s. to 15s. 3d. All descriptions of small steam coal offer abundantly. Stocks are very heavy and pressed on the market at the fixed minimum, best being 10s., special 10s. 6d., and ordinary 9s. 6d. Durham gas coals are well booked and any surplus output is readily cleared at 15s. Secondary gas coals, however, are irregular. Some fitters report being fully booked for the next week or two, while others are eager to secure orders to clear their present output. Prices indicated are unchanged at 13s. 3d. to 13s. 6d. Special Wear gas qualities are in larger supply at 15s. 6d. and Durham coking unscreened are plentifully offered at 13s. 3d. to 13s. 6d. All qualities of Durham bunkers are readily obtained at fairly easy range of values. Best are about 14s. 6d.; second descriptions, 13s. 3d. to 13s. 6d. Holders of gas coke report a few inquiries, but there are some prompt stocks on offer, and prices show no tendency to harden. Best qualities are offered at 21s., and district makes at 20s. Patent oven coke remains dull,

inquiries being few and far between. Buyers can cover all needs at easy late prices. Beehive and superior class foundry coke commands 24s. to 28s. 6d.

SCOTLAND.

(From our own Correspondent.)

A Drab Outlook.

No change is noticeable in the steel, iron and coal markets, and the outlook is disappointing in the extreme. On the whole, consumers of all classes of material have most moderate requirements, and, as a rule, will only negotiate for immediate deliveries. Here and there a slight movement in foreign inquiry is reported, but little is heard of actual business. Producers are more hopeful, however, that the usual seasonal expansion in certain markets will not be seriously delayed nor curtailed, though, so far as Australian business is concerned, the position is most doubtful.

Steel.

Producers in almost all branches of the steel trade are poorly placed, and a considerable amount of idle time is unavoidable. Specifications for plates and sections are especially disappointing, but makers cannot look forward to an early improvement with the shipbuilding industry in such a depressed condition. The turnover in sheets for export has been a shade better of late, but makers' galvanised descriptions are still inadequately supported in spite of easier prices for export. Steel tubes are very dull. Small diameter tubes are much more in demand than are the larger sizes. The butt-welded tubes branch is especially depressed.

Iron.

There seems little prospect of an improvement in the bar iron trade. Producers suffer in competition with steel products, and a lack of demand for tube works. Re-rolled steel bars likewise make little headway, despite easier prices, owing to home competition and to the low level of continental small bars. Quotations at present remain at £6 17s. 6d. home and £6 10s. per ton export.

Pig Iron.

The Scottish pig iron market has nothing fresh to report. Local demands remain at a very low ebb, and the position is made more difficult by continued offerings of Indian pig iron at cheap prices.

Scrap.

Apart from a gradual easing of prices, the scrap market is featureless. To-day, cast iron machinery scrap is quoted at 56s. 6d. and heavy steel at 47s. 6d. per ton.

Coal.

The principal feature in the Scottish coal market is the continued lack of export orders. This is, of course, due, in a measure, to the existing level of prices maintained owing to a curtailed output. Of late, land sales have begun to shrink and more large coal is becoming available, but prices have not yet been effected to any extent. Lanarkshire splints, ells, and steams and Lothians steams have a fairly steady outlet for decreased outputs, but Fifeshire best steams are not particularly well placed at present. On the whole, shipments are confined to small prompt lots. Aggregate shipments amounted to 172,751 tons, against 197,517 tons in the preceding week, and 264,976 tons in the same week last year. In all districts washed nuts are more plentiful at easier prices.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THERE can be no doubt that disappointment prevails that there has not been a perceptible expansion in the coal export trade during the past week or so. It was thought that last week's returns of shipments would have shown a marked improvement, inasmuch as the tonnage available at the ports at which steam coals are mainly shipped was, considering the circumstances, fairly good. It is to be feared, however, that coal-loading operations must have been on a slower scale, possibly for the reason that certain classes, such as sized qualities, were scarce, for, according to the G.W.R. Company's figures, shipments at the leading ports only came to 421,300 tons, which compared with 485,800 tons for the preceding week and with 613,646 tons for the same period of last year. When regard is paid to the total for twelve months ago, the fact is impressed upon one that there is very considerable leeway to be made up, yet at the same time the colliery position is not relatively worse because of the regulation of output, and the reduced quota which applies to this district for the current quarter. At the end of last week there were altogether thirty-nine tipping appliances at the various docks idle, but as against this, ten vessels were waiting at Cardiff to get into berth. This week the shipping position opened unusually well, as on Monday the number of idle tipping appliances was as low as eight and fourteen vessels were waiting to berth, but it is questionable whether this satisfactory state is likely to be maintained for long, as bad weather is interfering with the movement of steamers, and further chartering operations from day to day have rather contracted instead of expanding. This, in itself, does not mean, however, that orders have fallen off to any appreciable extent, as it is well known that merchants are experiencing difficulty in securing tonnage for prompt loading. There is a disposition on the part of shipowners to hold for an improvement upon the ruinous rates of freight which have ruled for so long, and they are not prepared to bring out steamers which have been laid up, unless they can obtain better rates. At the same time it cannot be said that the current demand from abroad for coals shows any real broadening, and business is still quiet, while, furthermore, there is not a great deal of business for delivery over a period. Since writing a week ago, the only contract which has been placed is that for the supply to the Norte Railways of Spain of 40,000 tons of large coals for delivery over the next two months. This order has been split up among three firms at prices which show the usual fierce competition. A fresh inquiry in the market is that from the Brazilian Central Railways for just over 100,000 tons of coal and patent fuel for delivery at Rio de Janeiro, commencing from early April. Tenders have to go in before the end of this month.

Independent Chairman Appointed.

News was received at the end of last week that the Lord Chief Justice had nominated Mr. Ferdinand Philip Maximilian Schiller, K.C., Recorder of Southampton, to be the independent chairman of the Joint Conciliation Board of the South Wales Coal Trade, and it is expected that he will meet the Board at the end of this or early next week in order to decide finally points at issue between the coalowners and miners. Under the new agreement both parties to it have undertaken to accept his decisions as binding.

Craftsmen's New Agreement.

A new agreement was entered into and signed by both sides when a meeting of the Enginemen and Craftsmen's Joint Wages Board for the South Wales Coal Trade was held at Cardiff on Tuesday. Negotiations have yet, however, to be completed in respect of the minimum percentage and subsistence wage to apply in accordance with the agreement.

Tube and Tin-plate Items.

It will be recollected that not long ago there was trouble between the management of the British Mannesmann Tube Works at Landore and their workmen on the question of working conditions, and eventually the points at issue went to arbitration. The latest development is that on Thursday of last week the management put up notices to the effect that owing to the award in the recent arbitration proceedings, the works will definitely close down at the end of this month, which means that about 1400 workmen will be affected. A later statement issued by the company is that the undertaking has been labouring under heavy handicaps, and it is impossible for the company to go on losing money month after month. The production costs are too high and other companies are producing a greater tonnage per man. As regards the tin-plate industry, it is reported that the Kidwelly works are again ceasing operations. The mill department closed down last Friday, while other departments are continuing until the stock has been dispersed. About 400 men are affected. As against this, the Morlais Works at Llangennech, resumed work last week after a six months' stoppage.

Tonnage.

Some interesting information is afforded by the statistical returns issued by the Cardiff Pilotage Authority for 1930. The number of vessels piloted in and out of Cardiff and Penarth was 5117, aggregating 8,495,636 net tons, which was a reduction of 302 vessels and 679,118 tons upon the figures for 1929. British vessels fell by 498 vessels, of 721,400 net tons, the total for 1930 being 1811 vessels, of 3,803,070 net tons, whereas foreign vessels were increased by 196, or 42,282 tons, to 3306, of 4,692,566 tons. This shows that during the past year more than half the coal shipped from Cardiff was carried in foreign-owned tonnage. With regard to the handling of the tonnage, it is shown that out of the total of 5117 vessels piloted in and out, which excludes a considerable number shifted between docks, casualties were reported to be only 27, or 0·5 per cent. of the total. In no case was extensive damage known to have been done, while in twelve instances the damage was slight, and in five cases there was no damage.

Current Business.

The steam coal market continues to display no special feature, and to all outward appearances new business is on the quiet side. The position of individual collieries, of course, varies to some extent, but so far as large coals are concerned, schedule prices operate, though most undertakings are comfortably stemmed. Small coals are plentiful and colliery salesmen experience difficulty in finding an outlet for them. Sized descriptions are very steady, and are not offered at all freely. There is no change in either coke or patent fuel, and orders would be welcomed. Pitwood has lost some of its steadiness, as arrivals of supplies are better.

INSTITUTION OF NAVAL ARCHITECTS.

THE seventy-second annual meeting of the Institution will take place on Wednesday, March 25th, and the two following days, in the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C. 2—by kind permission of the Council. Admiral of the Fleet the Right Hon. Lord Wester Wemyss, President, will occupy the chair.

The annual dinner will be given on Wednesday, March 25th, at 7.30 p.m., in the Grand Hall, Connaught Rooms, Great Queen-street, Kingsway, W.C. Evening dress and Orders will be worn.

At the invitation of the Association Technique Maritime et Aeronautique, the Summer Meeting will be held in Paris early in July, 1931. The International Exhibition at Vincennes, near Paris, will add to the interest of the meeting, and it is proposed that subsequently a visit will be paid to one of the shipbuilding centres in France.

A gold medal will be awarded by the Council to any person, not being a member or associate member of Council, who shall at the forthcoming meetings read a paper which, in the judgment of the Council, is deemed to be of exceptional merit. The Council will also offer a premium of books or instruments to the reader of any paper, not being a member or associate member of Council, which paper, in the judgment of the Council, merits this distinction.

SCHOLARSHIPS.

The following scholarships will be offered for competition in 1931 :—

Naval Architecture.—"Elgar"—£130 per annum for three years—entries closed January 15th, 1931. "Vickers-Armstrongs"—£150 per annum for three years—entries close July 31st, 1931.

Marine Engineering.—"Parsons"—£150 per annum for three years—and "Denny"—£75 per annum for four years. Entries close July 31st, 1931.

Post Graduate.—"1851 Exhibition Commissioners"—£250 per annum for two years—and the "Sir William White"—part-time, £150 per annum for two years.

Full particulars of these scholarships may be obtained on application to the Secretary.

CATALOGUES.

PRIESTMAN BROS, Ltd., Hull.—Publication No. 390 of universal excavators.

HOBDELL, WAY AND CO., Ltd., 20, St. Clare-street, E. 1.—"Petro-Flex" tubing catalogue.

JOHN A. SMEETON, Ltd., 15, Victoria-street, S.W. 1.—Particulars of the "Collin" patented tilting ladles.

MARSHALL, SONS AND CO., Ltd., Gainsborough.—Publication No. 2094/2BR on H type cold-starting heavy oil engines.

GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, W.C. 2.—Catalogue Section C of "Conduits and Fittings."

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE FARRAR BOILERWORKS, Ltd., Newark-on-Trent, has recently appointed Messrs. G. W. Risdon and Co., 11, Victoria-street, Westminster, London, S.W. 1, to represent the company in the London area.

DR. WALTER ROSENHAIN, F.R.S., has decided to sever his long connection with the National Physical Laboratory in order to take up private practice as a Research Adviser with a view to assisting firms in the application of research to industry. We understand that Dr. Rosenhain will leave the N.P.L. early in the summer and take offices in Westminster.

THE STEEL-MESH ROAD SURFACE COMPANY, Ltd., Park-street, Birmingham, which hitherto has marketed the reinforcement and armour for asphalt "Surfastal," has registered a new company under the name Surfastal, Ltd., in order to develop a new product "Surfastal-Unimats," which are specially designed for use with concrete, granolithic or other rigid surface material.

CONTRACTS.

H. TOLLEMACHE AND CO., of Canada House, Norfolk-street, Strand, W.C. 2, has received an order from John Lysaght, Ltd., Swan Garden Works, Wolverhampton, for a pulverised fuel plant. This plant is for the chilled roll melting furnaces at the Wolverhampton works.

THE STANTON IRONWORKS COMPANY, Ltd., has received an order from the Derby Gas Light and Coke Company for a cast iron main, 1¢ miles in length, consisting of 12in. and 15in. diameter De Lavaud spun iron pipes, fitted at each length with Stanton-Wilson flexible joints.

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), Ltd., has received an order from the Lancashire Steel Corporation, Ltd., for a battery of 51 Becker coke ovens, complete with by-product recovery plant. The contract also includes the supply of coal-handling, washing, blending and screening plant, coke-handling and screening plant, also benzol recovery and rectification plant.

THE UNDERFEED STOKER COMPANY, Ltd., Kingsway, London, informs us that a decision has now been reached regarding the firing equipment to be applied to the eight large boilers for the new 30,000-kW power plant to be installed in the Copenhagen municipality's power station. The stokers will be Underfeed Class "L" design, each boiler being fitted with a twin machine 6·8 m. wide by 6·8 m. long, giving a total grate surface of nearly 500 square feet.

THE MIRRLEES WATSON COMPANY, Ltd., has received an order from the London County Council, for Deptford pumping station, for two vertical spindle pumps to deal with 72 tons of sewage per minute against a head of 24ft., and one larger pump for 108 tons per minute against the same head. The driving units are vertical electric motors. Piping, valves, electrical controls, and an overhead crane are also included in the contract. The company has had an order from the Calcutta Electric Supply Company for four vertical spindle pumps, each to handle 10,000 gallons per minute against a head of 40ft.

BESSEMER GOLD MEDAL.—The Council of the Iron and Steel Institute have awarded the Bessemer Gold Medal this year to Professor Sir H. C. Harold Carpenter, F.R.S., M.A., Professor of Metallurgy in the Royal School of Mines, Imperial College of Science and Technology. The award is made in recognition of distinguished services rendered by Sir Harold Carpenter in the advancement of metallurgical science, and of the valuable research work performed by him in relation thereto.

MANCHESTER ASSOCIATION OF ENGINEERS.—A paper on the "Application of Electro-deposited Metals to Engineering" was read at a meeting of the Manchester Association of Engineers, held in Manchester on Friday, February 13th, by Mr. C. H. Faris, A.M.I. Mech. E. The Fescol process described is one by which it is possible to impose deposits of nickel, chromium, cadmium, and other metals upon steel, cast iron, &c., but unlike ordinary plating such deposits are unstrippable, and can only be removed from their base metals by machining or grinding. The thickness of the deposits in the case of nickel may vary between 0·001in. to 0·5in., according to requirements. There are two distinct classes of work, namely, the lighter coatings which are intended to prevent corrosion, and the heavier deposits which are applied to compensate for wear which has previously taken place. The author described and illustrated many examples showing the effect of the Fescol process, such, for instance, as the worn crank shafts of steam and internal combustion engines and hydraulic rams, built up to their original diameters by this means. To prevent corrosion, nickel, chromium, and cadmium can all be used for coatings, while for acid resistance, lead can also be applied with successful results. The author pointed out that the value of the Fescol process is considerably enhanced by reason of the absence of any heat treatment, especially where alloy steel, cast iron, or malleable iron parts are involved. He also stated that the machining of built-up parts presented no difficulties.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/- to 19/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 13 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 9 0	3 9 0
No. 1	3 9 6	3 9 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
(c) Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (a) / 4 3 6 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 15 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	8 15 0 to 9 5 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ½in.	8 0 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 2 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 5 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 12 6 and 9 2 6	—
Intermediate Basic	7 2 6 and 7 12 6	—
Soft Basic	6 5 0	—
Hoops	10 5 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 5 0	—
Billets and Sheet Bars	5 10 0 to 6 0 0	—
Galv. Sheets, f.o.b. L'pool	11 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 5 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/3 to 15/6
Block Tin (cash)	118 2 6
„ (three months)	119 15 0
Copper (cash)	45 15 0
„ (three months)	45 11 3
Spanish Lead (cash)	13 7 6
„ „ (three months)	13 10 0
Spelter (cash)	12 5 0
„ (three months)	12 11 3
MANCHESTER—	
Copper, Best Selected Ingots	48 10 0
„ Electrolytic	49 0 0
„ Strong Sheets	75 0 0
„ Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 1 0
Lead English	15 5 0
„ Foreign	13 15 0
Spelter	12 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/3 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£32 10 0	10/-
„ „ „ 1 p.c. carbon	£36 0 0	13/-
„ „ „ 0·70 p.c. carbon	£40 0 0	14/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£18 10 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/-
„ „ Ell	15/6
„ „ Splint	16/3 to 17/-
„ „ Trebles	13/-
„ „ Doubles	11/9 to 12/-
„ „ Singles	11/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/-
„ „ Jewel	17/-
„ „ Trebles	13/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/- to 12/6
Screened Navigation	16/6 to 17/6
Trebles	12/- to 13/6
Doubles	12/-
Singles	11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6
Secondary Steam	13/3
Trebles	13/-
Doubles	12/3
Singles	11/3

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		20/-
Household		30/- to 31/-
Coke		20/- to 20/6
NORTHUMBERLAND—		
Best Steams		13/6
Second Steams		12/6
Steam Smalls		10/- to 10/6
Unscreened		12/6 to 13/-
Household		27/- to 39/-
DURHAM—		
Best Gas		15/-
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		26/- to 28/-
SHEFFIELD—	Inland.	
Best Hand-picked Branch	25/6 to 27/-	—
Derbyshire Best Bright House	20/- to 22/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/- to 19/-	—
„ „ Nuts	15/6 to 16/6	—
Yorkshire Hards	14/- to 15/6	—
Derbyshire Hards	14/- to 15/6	—
Rough Slacks	8/6 to 9/-	—
Nutty Slacks	6/6 to 7/-	—
Smalls	3/- to 5/-	—
Blast-furnace Coke (Inland)	12/- on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		15/- to 16/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/6 to 18/-
Patent Fuel	21/6
Pitwood (ex ship)	25/3 to 25/9
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	20/3 to 21/6
Breaker Duff	9/6 to 10/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 21/6
Seconds	18/- to 20/-
Smalls	12/- to 13/-
Cargo Through	17/- to 18/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Cartel.

THERE have been pessimistic rumours about the Steel Cartel, the existence of which depends upon what can be done to ensure its final reconstitution at the end of March next. So far it does not appear that the executive commission has made much headway with the preliminary work, which is rendered extremely difficult by the widening gap between the claims of some producing countries that are manœuvring for larger quotas. The question of penalties for surplus production is also causing trouble. Again, a central sales organisation for foreign business is required by German steel makers, and, so far, attempts to centralise and distribute foreign orders at minimum prices have failed. There is also a tendency abroad to minimise the value of the services rendered by the Cartel because it has failed to give stability to the steel trade during a period of great depression, but if no organisation can ensure prosperity to an industry in times of bad trade, the Cartel has, at all events, shown that it is capable of checking a collapse. There is a general impression that the Steel Cartel must be renewed if the industry is to avoid disaster, and it is believed that, despite the entanglement of claims and the hostile attitude of some Belgian producers, it will be possible to take the only measure available for the salvation of the steel industry.

The Naval Programme.

The intention of the Government to include in the new instalment of the programme of naval construction the first of a series of three battle-cruisers as well as of some light cruisers, submarines and special craft is a definite indication that the French do not mean to relax their efforts to bring their navy to "a minimum strength necessary for the country's security." That minimum strength is avowedly determined by security in the Mediterranean and the keeping open of lines of communication with the colonies. The formula of minimum strength with security is elastic, and may be developed in many ways according to what other naval Powers may be doing. The announcement of the new instalment follows immediately upon the Italian proposal to increase considerably the expenditure upon naval construction during the present year. The inclusion of battle-cruisers in the French programme is a reply to the German efforts to depreciate the fighting value of the 10,000-ton cruisers built in France and elsewhere. This country has not taken advantage of the 70,000 tons of battleships allotted to it under the Washington Conference, because it had no use for ships while reconstituting its navy with fast cruisers and light craft, but this tonnage of heavy ships now enables it to score off against the Germans by building three battle-cruisers of 23,000 tons, which, it is said, will be far superior to the fast and powerful 10,000-ton "pocket battleships" built in Germany. It means that France aims at producing a type of battle-cruiser that, in speed and armament, will hold its own against anything afloat. It is quite hopeless to expect that France will make any concession to Great Britain in the way of armaments until it is sure of superiority over a combination of continental Powers. Unfortunately, there is nothing yet to show that there is likely to be an end to the competition in naval armaments, and, in fact, the building and arming of ships are regarded with favour at a time when so much work is needed in the arsenals and shipyards.

Wagon Cartel.

The International Union of Wagon Builders, which was formed with a view to co-ordinating foreign business and distributing orders to its members in agreed ratios, does not appear to have given such good results as had been anticipated. The members comprise Germany, Belgium, France, Italy, Czecho-Slovakia, Hungary, Austria, and Switzerland. The Union has been meeting with some opposition in Germany, while the abstention of Poland has made it necessary to effect some changes in the constitution of the Cartel. At a recent meeting in Paris, therefore, it was decided to change the Union into a company with a capital that will enable it to finance foreign railways for the purchase of rolling stock through the company.

Import Duties.

The British Board of Trade has sent to the different continental countries a note asking for a reduction of import duties on British textiles and machinery as a preliminary to a gradual suppression of tariffs. So far as France is concerned the note has been received with surprise. Of what use, is it asked, for Great Britain to appeal to continental countries for concessions when it can offer nothing in return? The note is incomprehensible to the French because there can be no reduction on the minimum scale of import duties except by a complete reform of the tariff, and if that were done the lower duties would have to be applied to all countries coming under the minimum scale. Such a reform would mean a "give-and-take" struggle for advantages, which would have to be very substantial to justify a sacrifice of interests in the textile and mechanical engineering industries of this country. The Roubaix weavers and spinners are suffering badly and would not tolerate any weakening of protection in the home market, and engineering firms complain that the effects of foreign competition are becoming increasingly severe. If the import duties on textiles and machinery were to be reduced it would mean that Great Britain would have to give ample compensating advantages in other ways.

Train Control.

One of the means employed by the State Railways to avoid congestion at the Gare Saint-Lazare is to reduce the running of locomotives between the terminus and the depôt on the arrival and departure of each local train by employing the same locomotive at the rear of the train on leaving the terminus. The driver is in the front coach with a brake control and a telephone to communicate with the fireman on the locomotive. This system is in use on trains made up with the new metallic coaches similar to those employed on the suburban electric trains. It appears to work quite satisfactorily.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES.

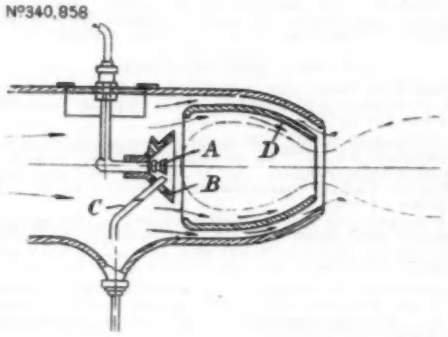
341,384. July 16th, 1930.—TRUNK LINE ELECTRIC CABLES WITH SCREENED CORES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In order to earth the metallic coatings which are arranged for screening the individual speech-circuits or speech-circuit groups within the core of trunk-line cables, use has hitherto been made of nettle-cloth bands which were worked through with thin metal wires. These bands, however, have the drawback that upon their application on the core of the cable, or upon bending of the cable, individual wires are liable to break and, owing to this, a continuous earthing is not possible. Moreover, there is the danger of the broken-off wires penetrating the insulation of the conductors and causing cable faults. According to the invention, these disadvantages are avoided by using metallised bands for earthing the screens in such a manner that over the entire length of the cable a continuous perfect earthing is ensured. The illustration shows a cable-core A, upon which two metallised paper bands B and C are so applied that the metallised side of the band B, indicated by a thick line, lies on the metallic screen D, whilst the metallised side of the band C, also indicated by a thick line, lies partly on the metallic side of the band B and partly on the lead jacket. —*January 15th*, 1931.

FURNACES.

340,858. February 27th, 1930.—BURNERS FOR HEAVY OILS, A. Lanser, Corseaux-Vevey, Switzerland.

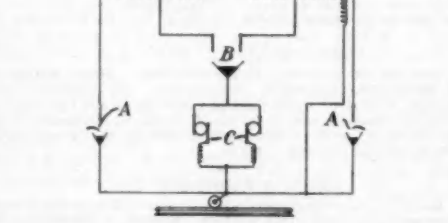
This burner is intended for heavy oils and has an atomiser at A, which is embraced by a deflecting cone B. Beneath the atomiser there is a drip pipe C, which carries away any oil which may dribble away on shutting down. The flame is blown into the double cone D, which is cooled by the passage of the secondary air through the annular space between the two cones.—*January 8th*, 1931.



LOCOMOTIVES.

341,173. November 8th, 1929.—ELECTRIC MOTOR VEHICLES, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

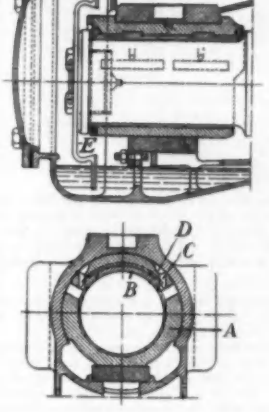
According to this invention high-tension D.C. from a line of supply is converted into D.C. of lower and preferably variable voltage for feeding the motors. The high-tension D.C. from the line supply is first transformed in the vehicle into A.C. of high periodicity by means of a transformer and rhythmically ionised and quenched vacuum valves A, and the A.C. is thereupon converted by means of a rectifier B into low-voltage D.C., which is supplied to the driving motors C. The conversion of the high-tension D.C. into A.C. of high periodicity has the advantage that it minimises the weight and dimensions of the transformer and thus enables the system to be housed in an electric vehicle. In order to alter the voltage of the transformed D.C., the secondary winding of the transformer can be provided with tappings arranged symmetrically with respect to the neutral point. Of these tappings, two symmetrically arranged tappings can be connected to the two anodes of the rectifier B by means of step switches.—*January 15th*, 1931.



TRAMWAYS AND RAILWAYS.

340,866. March 3rd, 1930.—AXLE BEARINGS, E. F. Matthews, Elm Cottage, Watford-road, Wembley, Middlesex.

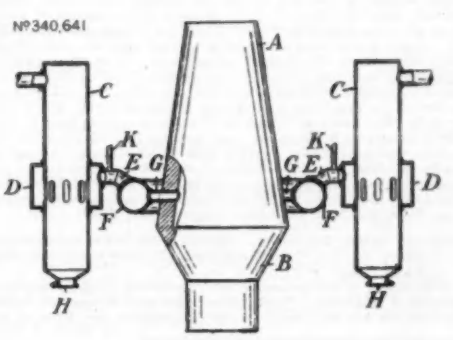
In this axle-box an effort is made to carry the weight on a pad uninterrupted by grooves or other means of introducing the lubricant. The shell A is a complete sleeve and is fitted with the bearing pad B. In the sides of the shell there are ports C which are fed with oil through the passages D by the dipper E. Some of the oil is drawn up by the journal, under the bearing pad for its lubrication, while the surplus falls back into the well to be used again. It will be noted that the complete shell supports the journal transversely.—*January 8th*, 1931.



METALLURGY.

340,641. October 11th, 1929.—PROCESS AND APPARATUS FOR THE PRODUCTION OF SPONGY IRON FROM IRON ORES, Fried. Krupp Aktiengesellschaft Friedrich-Alfred-Hütte, Rheinhausen (Niederrhein), Germany.

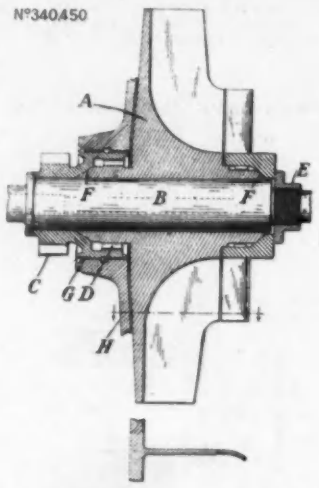
For the production of spongy iron from iron ores a gas is required, say the inventors, which contains as much carbon monoxide as possible and a working temperature of about 800 deg. Cent. and not appreciably more than 1000 deg. Cent. According to this invention, the production of spongy iron is attained economically by combining the process for the production of spongy iron with that for the reduction in the ordinary way in the blast-furnace of iron ore to produce pig iron, a current of gas taken from the blast-furnace and having a temperature of at least 800 deg. Cent. being caused to traverse a subsidiary shaft containing iron ore, so as to produce spongy iron, this spongy iron produced concurrently with the pig iron being discharged as a final product from the subsidiary shaft at will or continuously and not being fed to the blast-furnace. Whereas hitherto a separate producer for hot carbonic oxide gas or a carburetter for continuous regeneration of the reduction gas was used for the production of spongy iron, the lower part of the blast-furnace serves, by the present invention, as a generator for the reduction gas to be used in the subsidiary shaft, in addition to serving in the ordinary way for the reduction in the blast-furnace itself of iron ore to produce pig iron. With such a combination of a blast-furnace and a subsidiary shaft it is possible either to use the gas produced at the hearth of the blast-furnace if this exceeds a temperature of 1000 deg. Cent. for the reduction in the blast-furnace only or, in the event of a production of an excess of gas with a temperature below 1000 deg. Cent., to use such excess in the subsidiary shaft. The accompanying drawing serves to illustrate the process. A is the main shaft of the blast-furnace and B the lower portion thereof. C are the subsidiary shafts, each of which communicates by an annular conduit D and a pipe E through an annular conduit F and pipes G with the main shaft A. The subsidiary shafts C are in contradistinction to the main shaft filled with ore only. By draw-off openings H provided with means for closing them the spongy iron can be drawn off at will or discharged continuously through a gas-tight discharge apparatus. To regulate the working temperature, and particularly for warming up the charge, air may be admitted to the gas through a pipe K connected to the blast-pipe—not shown—and a portion of the gas burned, so that the temperature of the heating gas is increased, without the amount of carbonic acid exceeding permissible limits.—*January 8th*, 1931.



MISCELLANEOUS.

340,450. March 7th, 1930.—High-speed Rotors, D. Napier and Son, Ltd., J. M. Thomas, and H. G. Harley, 211, Acton-Vale, Acton, London, W. 3.

This invention appears to be concerned primarily with the rotors of superchargers for internal combustion engines, which,



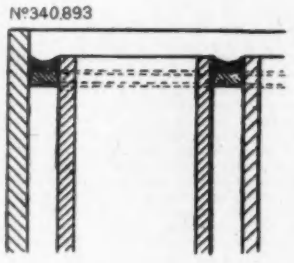
it is suggested, are liable to trouble through vibration. The impeller A is a fit on its shaft B, and is driven by the pinion C through the splines D. It is held in place by the nut E against the conical faces F F. A labyrinth packing is provided at G to prevent the passage of lubricant past the casing H.—*January 1st*, 1931.

340,868. March 5th, 1930.—A Process of Producing a Heat Conducting Bond, *Babcock and Wilcox, Ltd., Babcock House, Farringdon-street, London, E.C. 4.*

This invention relates to a process of producing a heat conducting bond that is especially useful as a cement or bond for connecting furnace tile or the like to water-cooled tubes. In a bond of this sort it is highly desirable for the bond to withstand reasonably high temperatures without deterioration. The bond should also be free from pores, which would interfere with its heat conductivity, and it should be sufficiently plastic so that when it is applied it will fill or be squeezed into all of the cracks or crevices to provide a continuous connection between the tile and the tubes. Heretofore it has been found in preparing a bonding material of this sort that by mixing the carborundum with water glass and glycerine the evolution of hydrogen often gives trouble by leaving the material in a porous condition, thereby decreasing its heat conducting qualities. According to the inventors, a heat conducting bond can be produced in which the danger of hydrogen being evolved, when the bond is put in place, is eliminated, thus assuring a more satisfactory product. Commercial carborundum contains free silicon, which would react with free alkali that is usually present in commercial sodium silicate to set hydrogen free. Not all of the hydrogen is set free during the time the bond is being prepared, with the result that the hydrogen that is evolved after the bond is in place produces the objectionable pores. The commercial carborundum, which contains free silicon, is consequently treated with an alkali, such as sodium hydroxide, and heated, after which the product is washed to remove any excess alkali. The washed product is then mixed with sodium silicate and glycerine to produce the bond. A small amount of iron oxide may be added. Also, a small amount of castor oil may be added to make the material work more easily when it is being applied. The following recipe is given in the specification:—Finely divided commercial carborundum that will pass through about a 300-mesh screen is treated with a somewhat greater amount of a solution of sodium hydroxide than is necessary to unite with all of the free silicon that is present in the carborundum, and the temperature is increased to the boiling point, thus driving off all of the hydrogen gas that is evolved in the reaction between the silicon and the sodium hydroxide. The amount of sodium hydroxide required will vary with the amount of free silicon in the carborundum, and can be quickly ascertained by a few tests with samples of the particular carborundum. The products are then washed to remove the excess sodium hydroxide. About twelve parts by weight of the treated carborundum is mixed with about four parts by weight of sodium silicate and three parts by weight of glycerine and heat is applied until the mixture has been brought to the desired consistency. A small amount of iron oxide—say, about one part by weight of iron oxide to ninety parts by weight of the mixture—may be added; 1 to 3 per cent. by weight of castor oil may also be added after the mixture has cooled. The material, which is in a plastic state, may be kept for a considerable length of time and applied between tile and tubes, whenever desired. The heat in the furnace, along the walls of which the tile are placed, causes the bond to set and provide a heat conducting cement or bond between the tile and the tubes that is free from pores and will satisfactorily conduct heat from the tile to the tube.—*January 8th*, 1931.

340,893. March 31st, 1930.—Tubular Heat Exchangers, W. Siller, No. 35, Vorgebergstrasse, Köln-on-the-Rhine, Germany.

The object of this invention is to crowd into a heat exchanger, such as a condenser or evaporator, the utmost amount of tube heating surface with narrow spaces in between the tubes so that



the velocity of the vapours is kept at the maximum, with a consequent improvement in the transfer of heat. The essential feature of the idea seems to be the welding of the tubes into the tube plates, instead of expanding them; but it is stipulated that the thickness of the tube plate should not be greater than that of the tubes by more than 2 mm.—*January 8th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note hat, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institute of Metals.—Official visit to the British Industries Fair at Birmingham. Full particulars may be obtained from Dr. G. Shaw Scott, 36, Victoria-street, London, S.W. 1.

Institution of Civil Engineers: Birmingham and District Association.—Visit to British Industries Fair.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London. Annual general meeting. The annual report of the Council will be presented. Annual election of Council. Papers will be read on "An Investigation of Steels for Aircraft Engine Valve Springs," by Mr. Andrew Swan, Mr. H. Sutton, and Mr. W. D. Douglas; and "The Fatigue Strength of Carbon and Alloy Steel Plates as Used for Laminated Springs," by Mr. R. G. C. Batson and Mr. J. Bradley. 6 p.m.

Junior Institution of Engineers.—At Royal United Services Institution, Whitehall. Special meeting. "Notes on the Construction of the Variable Density Tunnel for the National Physical Laboratory at Teddington," by Mr. A. J. Grant. 7.30 p.m.

Manchester Association of Engineers.—Midland Hotel, Manchester. Annual dinner. 6.45 for 7.15 p.m.

Physical Society.—At the Imperial College of Science, Imperial Institute-road, South Kensington. S.W. 7. "On the Velocity of Sound Waves in a Tube," by Mr. G. G. Sherratt and Mr. J. H. Awbery; "The Tube Effect in Sound Velocity Measurements," by Mr. P. S. H. Henry; "A Note on the Elimination of the β Wave-length from the Characteristic Radiation of Iron," by Mr. W. A. Wood. 5 p.m. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.

West of Scotland Iron and Steel Institute.—In the "Societies' Room," No. 24, Royal Technical College, George-street, Glasgow. "Durability of Refractories," by Mr. W. J. Rees. 7.15 p.m. The Council will meet at 6.45 p.m.

SATURDAY, FEBRUARY 21st.

Finsbury Technical College Old Students' Association.—At the Trocadero Restaurant. Annual dinner. Tickets from Mr. F. R. C. Rouse, 15, Clifton-gardens, Golders Green, London, N.W. 11.

North of England Institute of Mining and Mechanical Engineers.—In the Lecture Theatre of the Institute, Newcastle-upon-Tyne. Discussion, "Some Recent Improvements in Surveying Instruments," by Mr. W. H. Connell. The following paper will be read, "Old Mining Records and Plans," by Mr. T. V. Simpson. 2.30 p.m.

MONDAY, FEBRUARY 23rd.

Institution of Electrical Engineers: North-Eastern Centre.—At Armstrong College, Newcastle-upon-Tyne. "High-voltage Testing Equipments," by Messrs. E. T. Norris and F. W. Taylor; and "Dielectric Phenomena at High Voltages," by Messrs. B. L. Goodlet, F. S. Edwards, and F. R. Perry. 7 p.m.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, St. James's Park, London, S.W. 1. **"Fatigue in Metals," by Mr. D. G. Sopwith. 6.45 p.m.**

TUESDAY, FEBRUARY 24th.

Chadwick Public Lecture.—The Royal Sanitary Institute, 90, Buckingham Palace-road, S.W. 1. "Silicosis Prevention Methods," by Mr. E. A. Elsby. 8 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. "The Sinking of Trial Monoliths for King George's Dock, Calcutta," by Mr. John MacGlashan; and "Bombay Harbour Survey and Tidal Model," by Mr. John McClure. 6 p.m.

Institution of Electrical Engineers: North Midland Centre.—The Hotel Metropole, Leeds. "Apparatus and Methods for Accurate Maintenance of Large A.C. Energy Meters," by Messrs. E. Fawssett and G. E. Moore. 7 p.m.

Institution of Electrical Engineers: Scottish Centre.—At the Engineers' Rooms, 39, Elmbank-crescent, Glasgow, C. 2. "Wireless Telegraphy and the Upper Atmosphere," by Professor G. W. O. Howe. 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C. 2. "Supercharging, with Special Reference to Werkspoor Engines," by Mr. G. J. Lugt. 7.30 p.m.

Institution of Municipal and County Engineers: North-Western District.—In the Geological Lecture Theatre, Geological Department, at the Victoria University, Oxford-road, Manchester. "The Properties, Selection and Specification of Sandstones for Use as Kerbstones on Main Thoroughfares," by Mr. Edgar Morton. 6.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. "Adhesion," by Sir William Bragg. 5.15 p.m.

WEDNESDAY, FEBRUARY 25th.

North-East Coast Institution of Engineers and Shipbuilders.—In the Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. Tees-side Branch, Graduate Section. "Some Aspects of Mechanical Design," by Mr. H. McIvor. 7 p.m.

THURSDAY, FEBRUARY 26th.

Engineering Golfing Society.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual general meeting. 12.30 p.m.

Institute of Metals: Birmingham Local Section.—In the Chamber of Commerce, New-street, Birmingham. "Press Tools for Sheet Metal Working," by Mr. J. L. Williams. 7 p.m.

Institution of Electrical Engineers.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. Faraday Lecture on "The Birth of Electrical Engineering," by Professor W. Cramp. 6 p.m.

Institution of Locomotive Engineers.—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London, S.W. 1. "Compound Locomotives on the Paris-Lyons-Mediterranean Railway," by Mr. René G. E. Vallantin, Engineer-in-Chief of Material and Traction of the Paris-Lyons-Mediterranean Railway. 6 p.m.

FRIDAY, FEBRUARY 27th.

Institution of Electrical Engineers.—Armstrong College, Newcastle-on-Tyne. The Students' Lecture. "Overhead Line Work—More Especially in Connection with the Grid," by Mr. F. J. Baldwin.

Institution of Locomotive Engineers (London).—Trocadero Restaurant, Shaftesbury-avenue, London, W. 1. Annual dinner. 6.30 p.m. for 7 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—In the Mining Institute, Newcastle-on-Tyne. "Some Notes on Motor Engine Seatings," by Dr. J. Montgomerie. 6 p.m.

Institution of Municipal and County Engineers.—Visit of the West Midland District to the British Industries Fair, Castle Bromwich, Birmingham. 12.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "Oil Engines for the Maritime Fishing Industry," by Mr. W. A. Tookey. 7.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Re-birth of India," by Sir Francis Younghusband. 9 p.m.

SATURDAY, FEBRUARY 28th.

Hull Association of Engineers.—The Municipal Technical College, Hull. "Development of Unattended Navigation Lights," by Captain A. E. Butterfield. 7.15 p.m.

THURSDAY, MARCH 5th.

Institute of Transport.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner.

THURSDAY and FRIDAY, MARCH 5th and 6th.

Institution of Chemical Engineers.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1. *Thursday.*—"Flax Wax and its Extraction," by Mr. W. H. Gibson; "The Recovery of Gum from Fossil Kauri Timber," by Dr. R. G. Israel; "The Extraction of Terpene Chemicals from Waste Pine Woods," by Mr. I. W. Humphrey. 2.30 p.m. In the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. Public Lecture, "The New Italian Leucite Industry," by Baron Gian Alberto Blanc. 6.30 p.m. *Friday.*—At the Hotel Victoria, Northumberland-avenue, London, W.C. 2. Ninth annual corporate meeting. 11 a.m. Discussion, "The Education and Training of the Chemical Engineer." 11.45 a.m. Informal luncheon. 12.45 p.m. "The Flow of Gases at High Pressure Through Metal Pipes," by Dr. D. M. Newitt. 2.15 p.m. Grand Hall, Hotel Victoria. Ninth annual dinner. 7 for 7.30 p.m.

FRIDAY, MARCH 6th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Lantern lecture, "The Netherlands East India State Railways and Electrification," by Mr. A. M. Hug. 7 p.m.

Junior Institution of Engineers.—Science Museum, South Kensington, S.W. 7. Lecture on "The Historic Locomotives at the Museum." Inspection of exhibits. 7.30 p.m.

WEDNESDAY and THURSDAY, MARCH 11th and 12th.

Institute of Metals.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual general meeting.

FRIDAY, MARCH 13th.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "Phenol Formaldehyde Moulding Compositions, Manufacture and Use," by Mr. Leonard Clegg. 7.30 p.m.

WEDNESDAY, MARCH 25th.

Association of Special Libraries and Information Bureaux.—At the Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. "George Stephenson's Institute and its Library." 7 p.m.

MONDAY, APRIL 13th.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Debate upon the Final Report of the Royal Commission on Transport. 5.30 p.m.

FRIDAY and SATURDAY, APRIL 17th and 18th.

Faraday Society.—The Department of Chemistry, The University, Liverpool. General discussion on "Photochemical Processes." I.: "Molecular Spectra in Relation to Photochemical Change," Friday, 10 a.m., introductory paper by Professor R. Mecke; II.: "Photochemical Kinetics in Gaseous Systems," Friday, 2.30 p.m., introductory paper by Professor M. Bodenstein; III.: "Photochemical Change in Liquid and Solid Solutions," Saturday, 10 a.m., introductory paper by Professor Berthoud; IV.: "Photosynthesis," Saturday, 2.30 p.m., introductory paper by Professor E. C. C. Baly.

EDUCATIONAL INTELLIGENCE.

A course of four lectures on "Dielectrics" will be delivered at the Northampton Polytechnic Institute, St. John-street, London, E.C. 1, on Wednesdays, commencing March 4th, 1931. The lectures will deal with the phenomena of leakage, absorption, power losses in alternating fields, dielectric strength, &c., and will be particularly addressed to those concerned with the manufacture and industrial applications of insulating materials.

University of London.—A course of four lectures on "Hardness and Hardening," will be given at the Imperial College, Royal School of Mines, Prince Consort-road, S.W. 7, by Dr. W. Rosenhain, F.R.S., Superintendent of the Metallurgy Department in the National Physical Laboratory, at 5.30 p.m., on March 2nd, 9th, 16th and 23rd, 1931. At the first Lecture the chair will be taken by Professor Sir Henry C. H. Carpenter, Ph.D., M.A., F.R.S., Professor of Metallurgy in the University. The Lectures, which will be illustrated with lantern slides, are addressed to students of the University and to others interested in the subject. Admission free, without ticket.

Institution of Civil Engineers.—The tenth annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held on Wednesday, 11th inst., at the Midland Hotel, Manchester. Mr. W. F. H. Creber, M. Inst. C.E., Chairman of the Association, presided, and the chief guest was Sir George W. Humphries, President of the Institution. In accordance with the custom of the branch, the principal toast, that of "The Institution of Civil Engineers," was proposed by a student, in this case Mr. D. M. Waite, B.Sc. (Tech.). Mr. Waite performed his task with credit. He referred to the reputation which the President had built up in connection with engineering schemes for docks, railways, roads and cities. In replying to the toast, Sir George said that the Institution represented all that was best and most efficient in the engineering world. He quoted some figures with regard to the growth of the Institution, and said that the membership was now 10,483, but the membership of the Manchester and District Association showed a decrease during the past year. The toast of "The Manchester and District Association" was proposed by Major-General W. H. Beach, and was acknowledged by the Chairman in a humorous speech. The toast of "The Guests" was proposed by Mr. J. Harcourt Williams, M. Inst. C.E., deputy chief engineer to the Manchester Corporation Electricity Department, and Mr. F. S. Stancliffe, President of the Manchester Law Society, responded. In response to the toast of "The Officers of the Association," Mr. G. W. Lord, hon. secretary, made an appeal for further members and better attendances at the Association meetings.